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BREEDING STATUS AND POPULATION TRENDS OF SEABIRDS IN ALASKA IN 1998

Compiled By:

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EXECUTIVE SUMMARY

Data are being collected annually for selected species of marine birds at breeding colonies on the far-flung Alaska Maritime National Wildlife Refuge (NWR) and at other areas in Alaska to monitor the condition of the marine ecosystem and to evaluate the conservation status of species under the trust of the Fish and Wildlife Service. The strategy for colony monitoring includes estimating timing of nesting events, rates of reproductive success (e.g., chicks per nest), and population trends of representative species of various foraging guilds (e.g., off-shore diving fish-feeders, offshore surface-feeding fish-feeders, diving plankton-feeders) at geographically-dispersed breeding sites. This information enables managers to better understand ecosystem processes and respond appropriately to resource issues. It also provides a basis for researchers to test hypotheses about ecosystem change. The value of the marine bird monitoring program is enhanced by having sufficiently long time-series to describe patterns for these long-lived species.

In summer 1998 data were gathered on fulmars, storm-petrels, cormorants, gulls, kittiwakes, murres, auklets, and/or puffins at 10 annual monitoring sites on the Alaska Maritime NWR, 1 annual monitoring site on the Togiak NWR, and an annual monitoring site on private land (Little Diomede). In addition, data were gathered at 7 other locations which are visited intermittently or are currently part of an intensive research program off refuges (e.g., Exxon Valdez Trustee Council-sponsored research in Prince William Sound).

In 1998, we recorded few cases of earlier than normal hatching. Instead, most species were within normal bounds or were later than average. Diving plankton feeders (auklets) were late in most cases. Fish feeders (cormorants, gull, kittiwakes, murres, puffins) were later than normal in 6 of 13 cases (species x site) in the southeastern Bering Sea and in 7 of 12 cases in the northern Gulf of Alaska.

Plankton feeders (storm-petrels and auklets) had average rates of reproductive success in nearly every case where we monitored them in 1998. For surface fish feeders, gulls had average rates of success in 6 of 7 cases, but the productivity of kittiwakes varied among regions. At Chukchi and Bering Sea locations (Chukchi and northern Bering) kittiwakes generally had average or higher success, but in the Gulf of Alaska, success was lower than average in 5 of 7 sites. Monitored species of diving fish feeders (cormorants, murres, and puffins) had average or higher rates of productivity at most sites in the northern Bering and Chukchi seas and Southeast regions, but in the southern Bering Sea and Gulf of Alaska, below-average success was recorded for the majority of species and colonies (22 of 35 cases of species x sites).

Storm-petrel populations appeared to be increasing where we monitored them in 1998 (the Aleutians and Southeast). Trends varied among sites for cormorants; some up, some down and some level. For other species of fish feeders (gulls, kittiwakes, murres, puffins), we saw no evidence of sustained declines at most sites surveyed.

Although the now-famous El Niño of 1997-1998 was abating by summer 1998 in Alaska, there may have been some residual effect on the marine food webs exploited by seabirds which delayed the onset of nesting and may have reduced reproductive success in the southern Bering Sea and Gulf of Alaska regions.

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INTRODUCTION

This report is the third in a series of annual reports summarizing the results of seabird monitoring surveys at breeding colonies on the Alaska Maritime National Wildlife Refuge (NWR) and elsewhere in Alaska (see Byrd and Dragoo 1997, and Byrd et al. 1998 for compilations of previous years' data). This report series is patterned after the publications of the Joint Nature Conservation Committee in Britain (e.g., Thompson et al. 1999). Like the British seabird monitoring program, the program in Alaska is designed to keep track of selected species of seabirds that indicate changes in the marine environment. Furthermore, the U.S. Fish and Wildlife Service has the responsibility to conserve seabirds, and monitoring data are used to identify conservation problems. The objective is to provide long-term, time-series data from which biologically-significant changes may be detected and from which hypotheses about causes of changes may be tested.

The Alaska Maritime NWR was established specifically "To conserve marine bird populations and habitats in their natural diversity and the marine resources upon which they rely" (Alaska National Interests Land Conservation Act of 1982), and the monitoring program is an integral part of the management of this refuge. Although approximately 80% of the seabird nesting colonies in Alaska occur on the Alaska Maritime NWR, marine bird nesting colonies occur on other public lands (national and state refuges) and on private lands as well. The strategy for colony monitoring includes estimating timing of nesting events, reproductive success, and population trends of representative species of various foraging guilds (e.g., murres are off-shore diving fish-feeders, kittiwakes are offshore surface-feeding fish-feeders, auklets are diving plankton-feeders, etc.) at geographically dispersed breeding sites along the entire coastline of Alaska. A total of 12 sites (Fig. 1), located roughly 300-500 km apart, are scheduled for annual surveys, and data were available for all of these in 1998. In addition, colonies near the annual sites are identified for less frequent surveys to "calibrate" the information at the annual sites. Furthermore, other research projects (e.g., those associated with evaluating the impacts of oil spills on marine birds) supplement the monitoring database.

In this report, we summarize information from 1998 for each species; i.e., tables with estimates of average hatch dates and reproductive success and maps with symbols indicating the relative success at various sites. In addition, historical patterns of productivity are illustrated for most annual monitoring sites (those where we have information). Population trend information is included for sites where data were gathered in 1998.

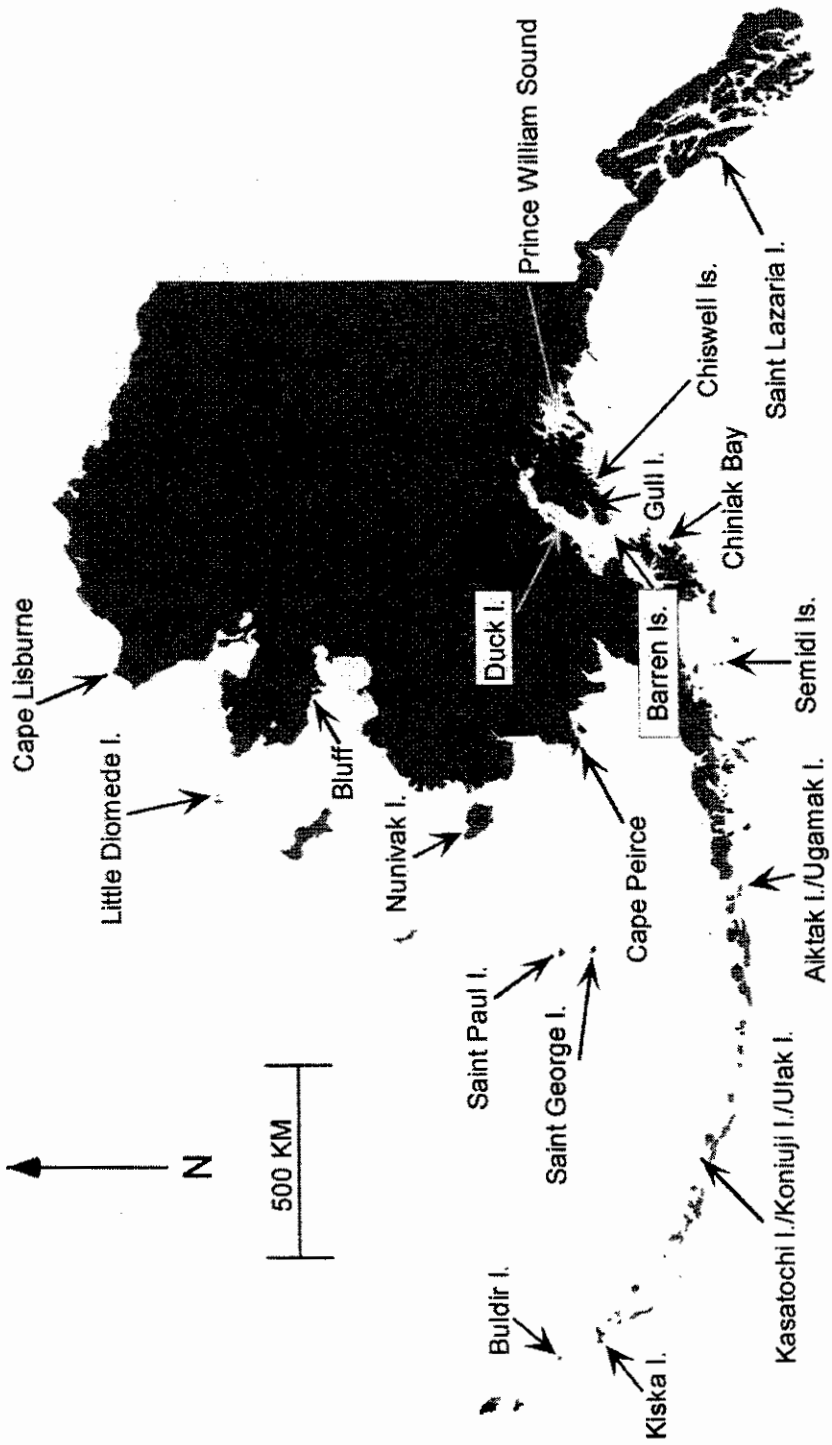

Figure 1. Map of Alaska showing the locations of seabird monitoring sites summarized in this report.

METHODS

Data collection methods generally followed protocols specified in "Standard Operating Procedures for Population Inventories" (USFWS 1997*a, b, c*). Timing of nesting events and productivity usually were based on periodic checks of samples of nests (frequently in plots) throughout the breeding season, but a few estimates of productivity were based on single visits to colonies late in the breeding season (so noted in tables). Hatch dates commonly were used to describe nesting chronology. Productivity typically was expressed as chicks fledged per egg, but occasionally other variables were used (e.g., chicks hatched per egg, chicks fledged per nest site). Population surveys were conducted for ledge-nesting species at times of the day and breeding season when variability in attendance was reduced. Most burrow-nester counts were made early in the season before vegetation obscured burrow entrances. Deviations from standard methods are indicated in reports from individual sites which are referenced appropriately.

This report summarizes monitoring data for 1998, and compares 1998 results with previous years. For sites with four or more years of data prior to 1998, site averages were used for comparisons. Otherwise, prior estimates for nearby sites were utilized for comparisons. For chronology, we considered dates within 3 days of the long-term average "normal"; larger deviations represented relatively early or late dates. For productivity, we defined significant deviations from "normal" as 20% or greater from the site or regional average. We used the phrase "slightly" above or below average to indicate smaller differences. We described overall population trends from exponential regression models.

RESULTS

Northern Fulmar (*Fulmarus glacialis*)

Breeding Chronology.--The mean laying date (15 June, n= 80 nests) of northern fulmars was a few days later than usual in 1998 at the Semidi Islands (Nevins and Adams 1998), the only location where we obtained this kind of information (long-term mean is 10 June, n=9 years).

Productivity.--Fulmars had lower than normal productivity in 1998 at the Semidi Islands (0.12 chicks fledged/egg, sd=0.06, n=103 nests on 9 plots), where the average reproductive rate has been 0.36 chicks fledged/egg in 15 years of observations between the mid-1970s and mid-1990s (Hatch 1987, Nevins and Adams 1998).

Populations.--We counted fulmars at only one location in 1998; Chowiet, in the Semidi group. Numbers there were lower than in recent years (Fig. 2). This count does not necessarily mean populations are declining. Possibly a smaller proportion of the breeders that normally would have been associated with this colony attended the cliffs in 1998 due to poor conditions for breeding (suggested by the low reproductive rates of birds that did attend the colony). Populations had been increasing in the Semidis prior to the 1998 count (Fig. 2).

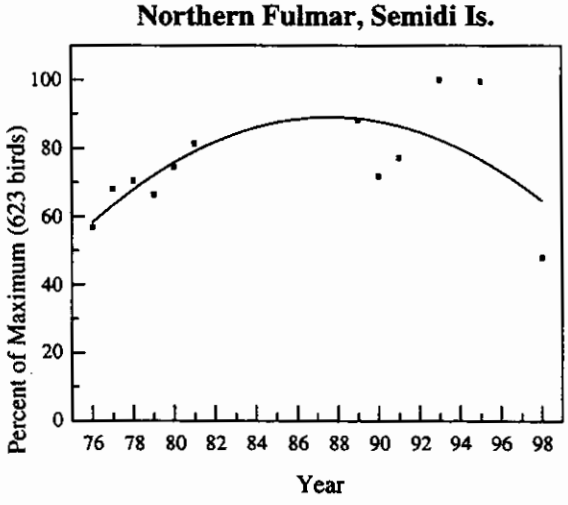

Figure 2. Trends in populations of northern fulmars at Alaskan sites monitored in 1998.

Fork-tailed (*Oceanodroma furcata*) and Leach's (*O. leucorhoa*) Storm-Petrels

Breeding Chronology.--Typically, fork-tailed storm-petrels begin annual nesting earlier than Leach's storm-petrels, and that was true at St. Lazaria in 1998 (Table 1). Both species nested at average or slightly earlier than average dates in 1998 at St. Lazaria.

Table 1. Hatching chronology of storm-petrels at Alaskan sites monitored in 1998.

Site/Species	Median	Mean	Long-term Average	Reference
Fork-tailed				
Saint Lazaria I.	18 Jul (42)[a]	19 Jul (42)	21 Jul[b] (3)[a]	L. Slater Unpubl. Data[c]
Leach's				
Saint Lazaria I.	28 Jul (55)	30 Jul (55)	2 Aug[b] (3)	L. Slater Unpubl. Data[c]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual means
[c]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Productivity.--In 1998, productivity of fork-tailed and Leach's storm-petrels ranged from over 85% at Buldir to 60% at Ulak (Table 2, Figs. 3 and 4). The two species had similar rates of success at Buldir and St. Lazaria, but Leach's storm-petrels had a lower rate of success than fork-tailed storm-petrels at Aiktak in 1998. Compared to previous years, both species had approximately average or slightly above average success at all three sites where data were available.

Populations.--In 1998, counts of burrow entrances were made in monitoring plots at St. Lazaria, Aiktak and Ulak (all annual sites). It appears that populations are increasing at St. Lazaria, where counts in 1998 were the highest we have recorded there (Fig. 5). Burrow counts at Aiktak in 1998 were similar to 1997, but the overall trend there is up substantially since 1990, and recent increases also have been recorded at Ulak.

Table 2. Reproductive performance of storm-petrels at Alaskan sites monitored in 1998.

Site/Species	Chicks Fledged[a]/egg	No. of Plots	No. of Eggs	Reference
Fork-tailed				
Buldir I.	0.85 (0.04)[b]	1	74	Williams et al. 1999
Ulak I.	0.60 (0.06)	1	63	Scharf 1998
Aiktak I.	0.80 (0.06)		39	S. Woodward Unpubl. Data[c]
Saint Lazaria I.	0.66 (0.01)	7	212	L. Slater Unpubl. Data[d]
Leach's				
Buldir I.	0.83 (0.08)[b]		40	Williams et al. 1999
Aiktak I.	0.63 (0.05)		87	S. Woodward Unpubl. Data[c]
Saint Lazaria I.	0.72 (0.17)	11	184	L. Slater Unpubl. Data[d]

[a]Fledged chick defined as being still alive at last check in August or September.
[b]Standard deviation in parentheses.
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

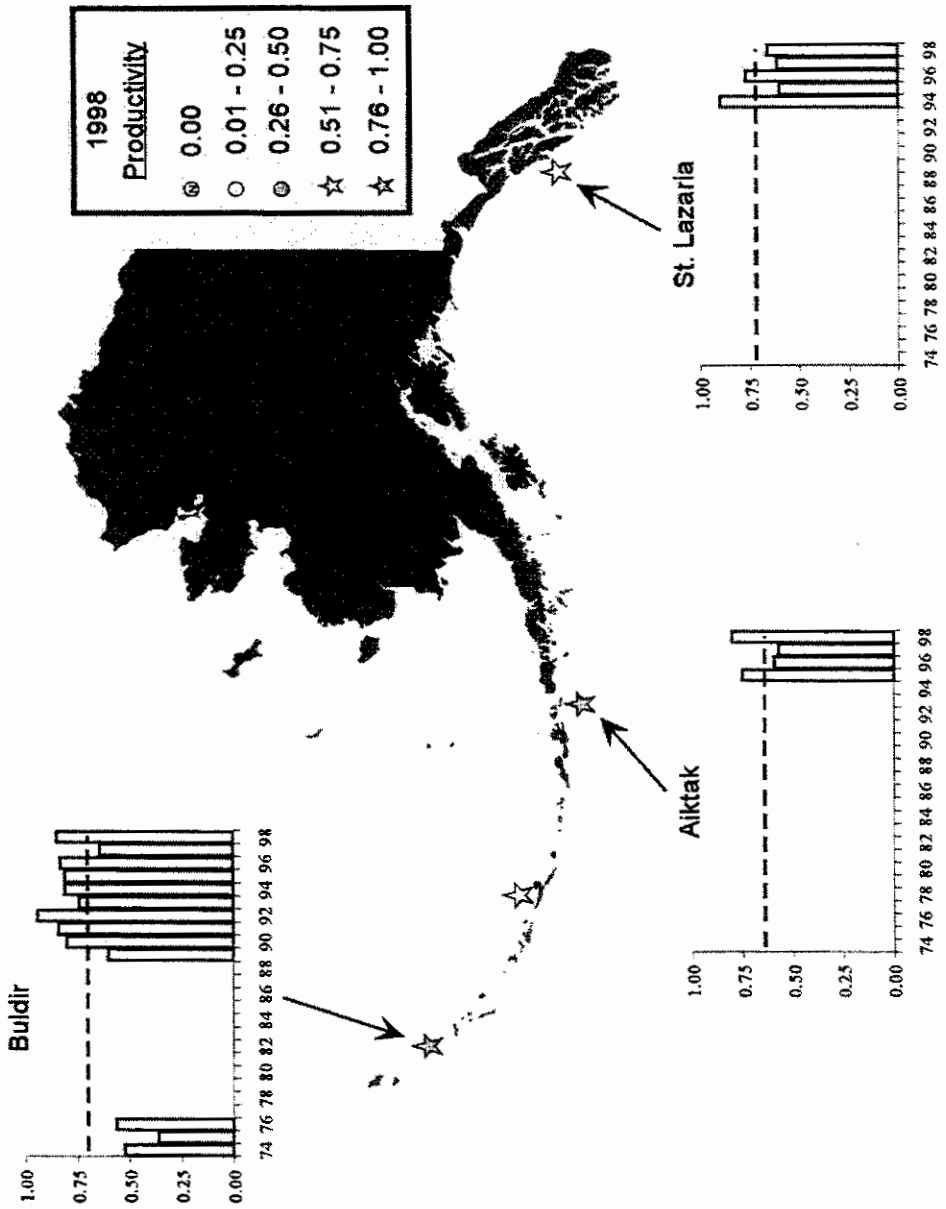

Figure 3. Productivity of fork-tailed storm-petrels (chicks/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

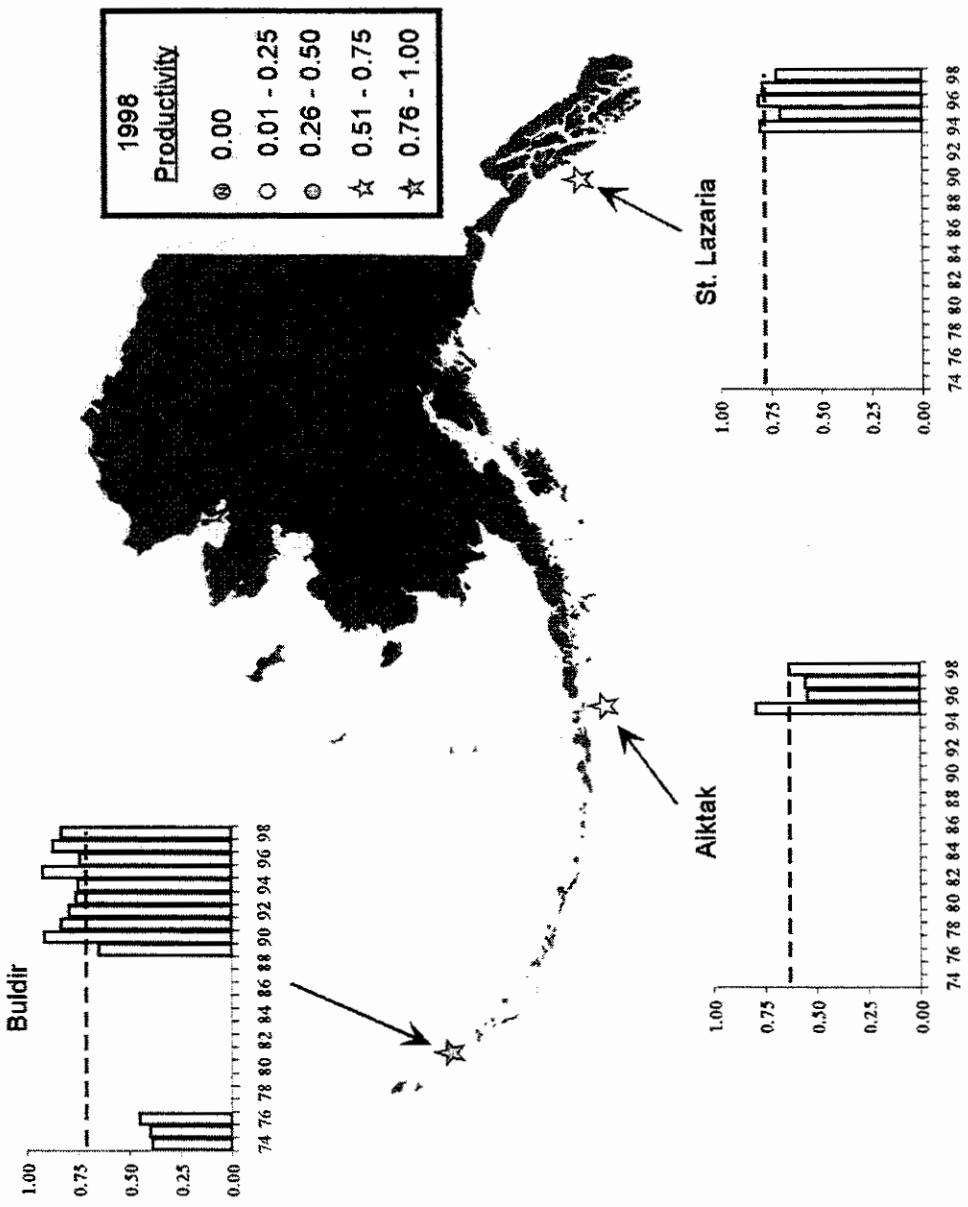

Figure 4. Productivity of Leach's storm-petrels (chicks/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

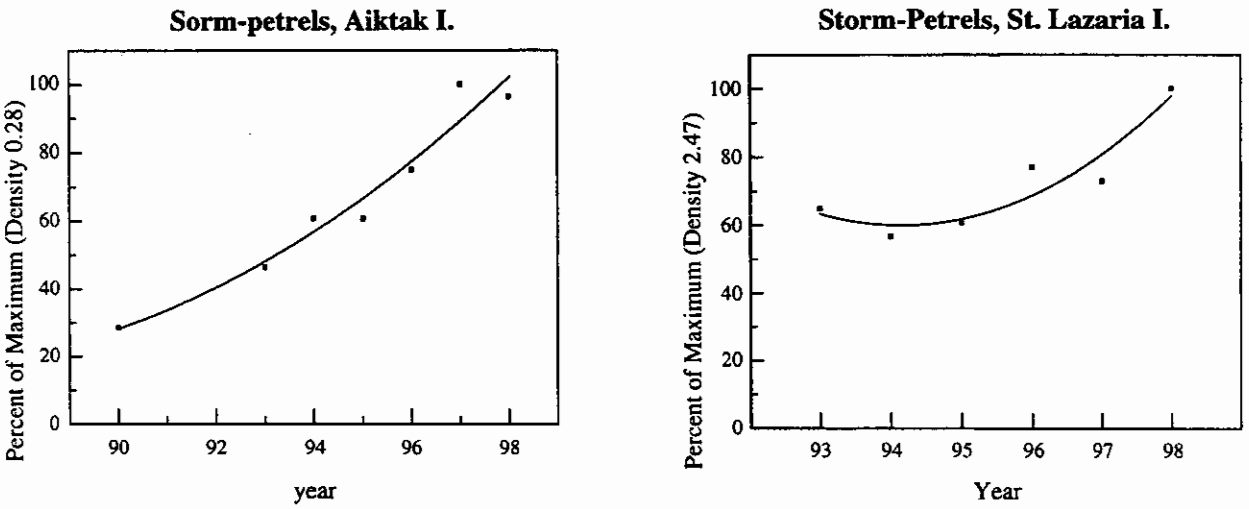

Figure 5. Trends in populations of storm-petrels at Alaskan sites monitored in 1998.

Double-crested Cormorant (*Phalacrocorax auritus*)

Productivity.--Double-crested cormorants averaged nearly 2 chicks per nest at Aiktak, but the species failed to produce young at Duck in 1998 (Table 3, Fig. 6). There is little prior information for this species at these two sites.

Table 3. Reproductive performance of double-crested cormorants at Alaskan sites monitored in 1998.

Site	Chicks/Nest	No. of Nests	Reference
Aiktak I.	1.8 (1.6)[a]	11	S. Woodward Unpubl. Data[b]
Duck I.	0.00	25	T. Van Pelt Unpubl. Data[c]

[a]Standard deviation in parentheses
[b]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[c]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999

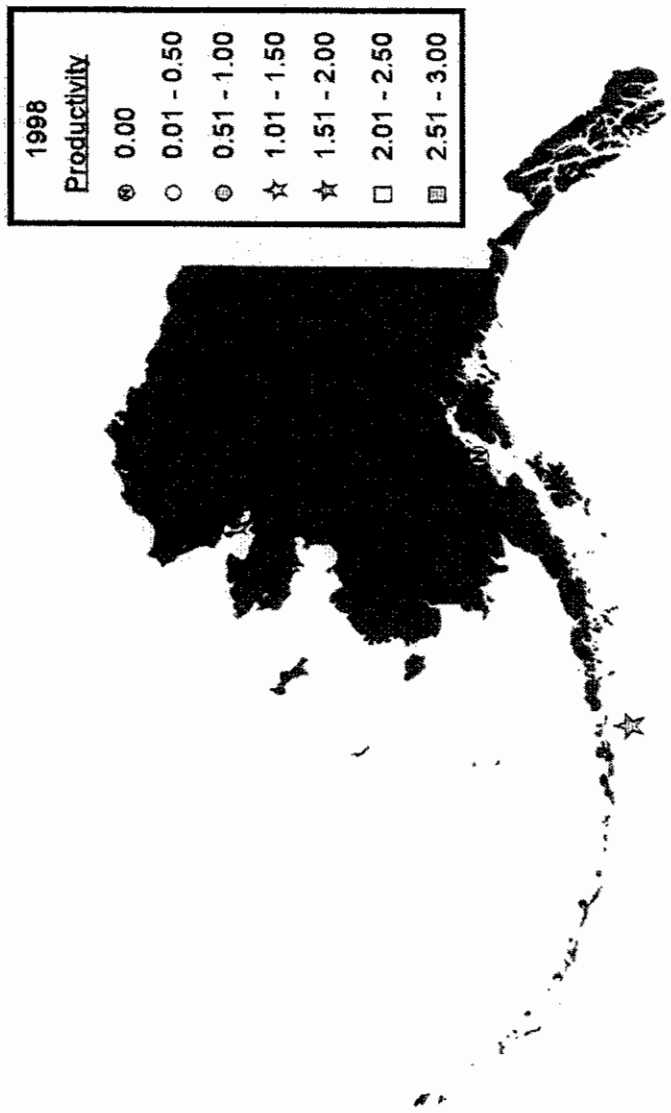

Figure 6. Productivity of double-crested cormorants (large chicks/nest) at Alaskan sites monitored in 1998.

Pelagic Cormorant (*Phalacrocorax pelagicus*)

Breeding Chronology.--Information on breeding chronology of pelagic cormorants was obtained only at Cape Peirce in 1998, where the mean hatch date was 18 June, equal to the long-term average (n=6 years) (MacDonald 1999).

Productivity.--Generally, the index to productivity for cormorants is obtained by single visits to nesting colonies late in the chick-rearing period when chicks are clearly visible. The parameter, "large chicks per nest", is used to describe productivity rates. Productivity varied substantially among sites in 1998 ranging from a complete failure at Chiniak Bay to a high of 2.0 chicks per nest at Bluff (Table 4, Fig. 7). Pelagic cormorants had lower rates of success in southwestern Alaska in 1998 than farther north. Compared to past years, success was lower than average at Cape Peirce, Buldir, and Chiniak Bay in 1998 but was nearly normal at St. Lazaria (Fig. 7).

Table 4. Reproductive performance of pelagic cormorants at Alaskan sites monitored in 1998.

Site	Chicks/Nest	No. of Plots	No. of Nests	Reference
Bluff	2.0		17	Murphy 1999
Nunivak I.	1.29 (1.10)[a]		66	C. Harwood Unpubl. Data[b]
Cape Peirce	0.80 (0.23)	6	125	MacDonald 1999
Buldir I.	0.60 (0.09)	1	29	Williams et al. 1999
Kasatochi I.	0.60	1	36	Scharf 1998
Ulak I.	0.60	1	5	Scharf 1998
Ugamak I.	1.2 (1.3)	1	19	S. Woodward Unpubl. Data[c]
Aiktak I.	1.0 (1.4)	1	5	S. Woodward Unpubl. Data[c]
Chiniak Bay	0.00		130	D. Irons Unpubl. Data[d]
Gull I.	1.36		58	M. Shultz Unpubl. Data[e]
Saint Lazaria I.	1.19 (0.41)	2	94	L. Slater Unpubl. Data[f]

[a]Standard deviation in parentheses
[b]Harwood, C., Yukon Delta NWR, USFWS. Unpublished Data, 1998
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Irons, D. B., Migratory Bird Management, USFWS. Unpublished Data, 1999
[e]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998. Index based on one count during early incubation and one during late chick-rearing.
[f]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

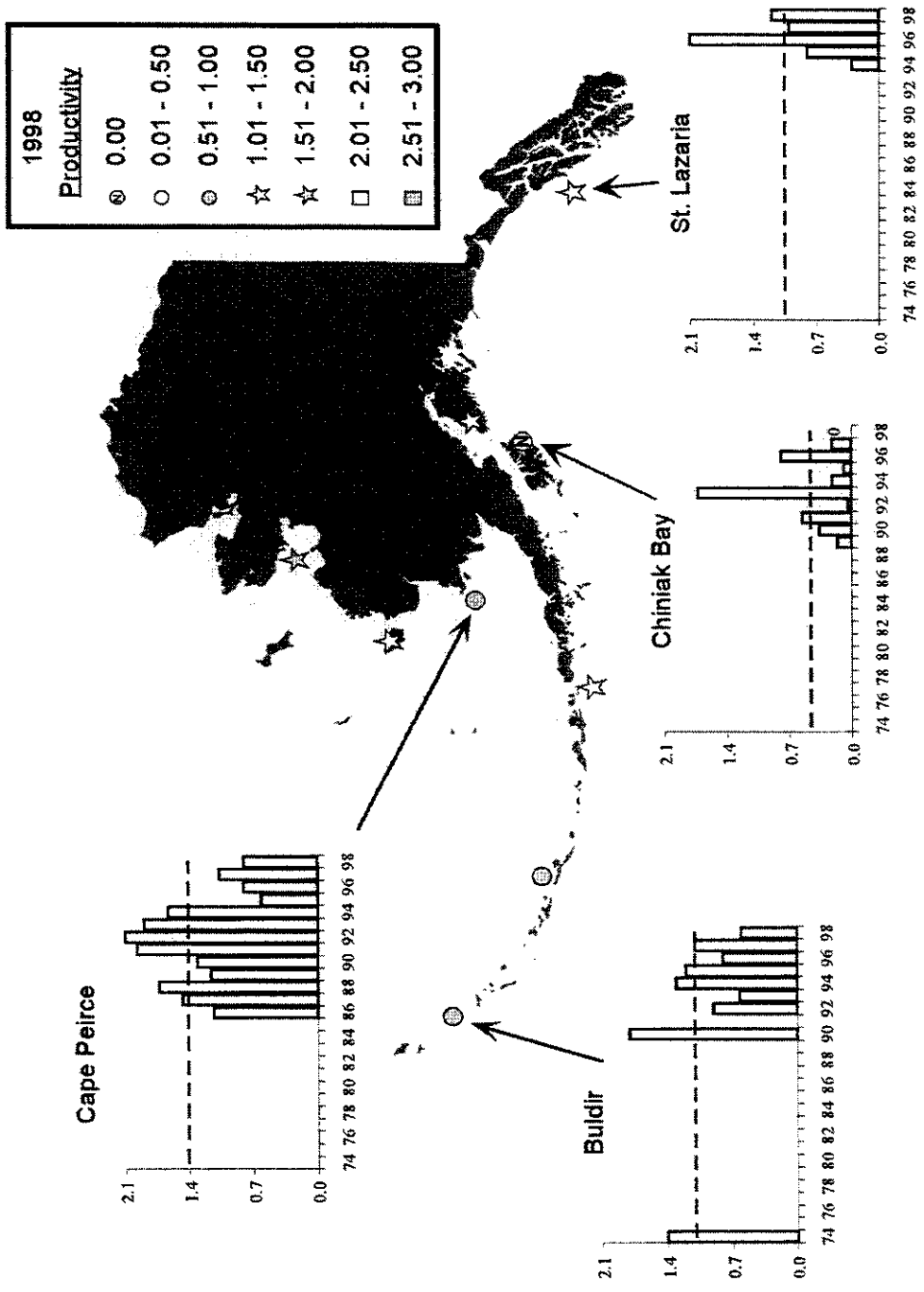

Figure 7. Productivity of pelagic cormorants (large chicks/nest) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Populations.--Cormorants are known to shift nesting locations between years, so it is difficult to confidently interpret changes in counts. Nevertheless, numbers of pelagic cormorants or nests (the index that has been used at some sites) have declined at sites in the western Gulf of Alaska (Chiniak Bay), but have increased at Cape Peirce and St. Lazaria (Fig. 8).

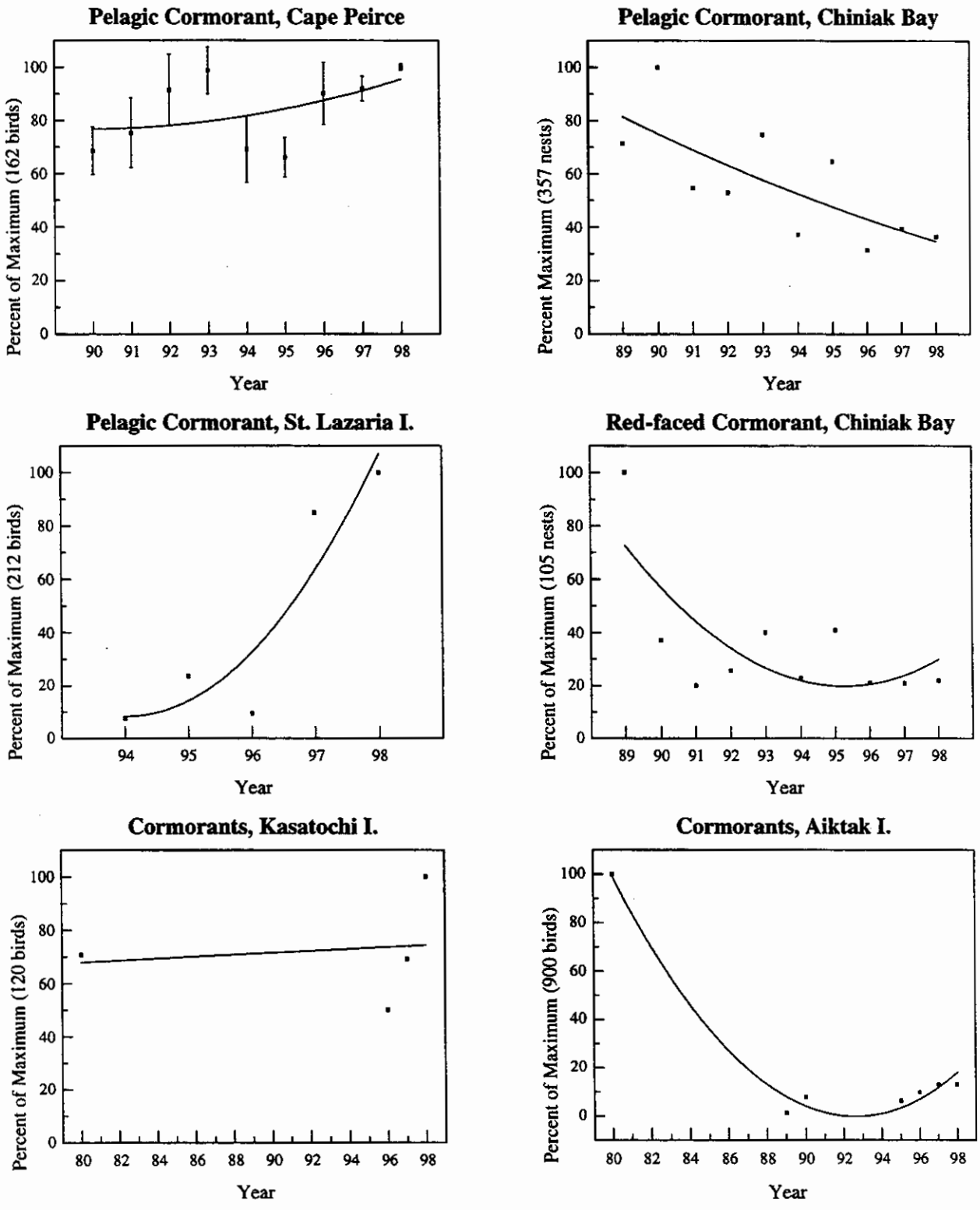

Figure 8. Trends in populations of cormorants at Alaskan sites monitored in 1998. Error bars (90% confidence intervals) are shown for years with multiple counts.

Red-faced Cormorant (*Phalacrocorax urile*)

Breeding Chronology.--The average hatching date for red-faced cormorant eggs was 6 July, 5 days later than the long-term average in the Pribilofs (St. Paul, Carten and Sommer 1998).

Productivity.--In 1998, productivity of red-faced cormorants ranged from failure at Chiniak Bay to a relatively high rate of success (1.0-1.2 chicks per nest) at St. Paul, Kasatochi, and Ulak. Success was lower in the eastern Aleutians at Aiktak (Table 5, Fig. 9). At St. Paul, where we have a good historical database, success was relatively high in 1998 (Fig. 9). Productivity was average or higher in 1998 at Aiktak and Ulak when compared to the long-term means for those sites.

Populations.--As with pelagic cormorants, shifting among sites occurs in red-faced cormorants. In 1998, red-faced cormorant numbers continued to remain low compared to 1970s levels at Chiniak Bay. At Kasatochi, where numbers of cormorants (mostly red-faced) were higher in 1998 than in recent years, overall trends were approximately level (Fig. 8). At Aiktak (where most were red-faced in 1998), numbers of cormorants were similar to 1997, but numbers remain lower than in 1980.

Table 5. Reproductive performance of red-faced cormorants at Alaskan sites monitored in 1998.

Site	Chicks/Nest	No. of Plots	No. of Nests	Reference
Saint Paul I.	1.00 (0.40)[a]	4	63	Carten and Sommer 1998
Kasatochi I.	1.20	1	34	Scharf 1998
Ulak I.	1.20	1	22	Scharf 1998
Aiktak I.	0.59	1	95	S. Woodward Unpubl. Data[b]
Chiniak Bay	0.00	1	23	D. Irons Unpubl. Data[c]

[a]Standard deviation in parentheses
[b]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[c]Irons, D. B., Migratory Bird Management, USFWS. Unpublished Data, 1999

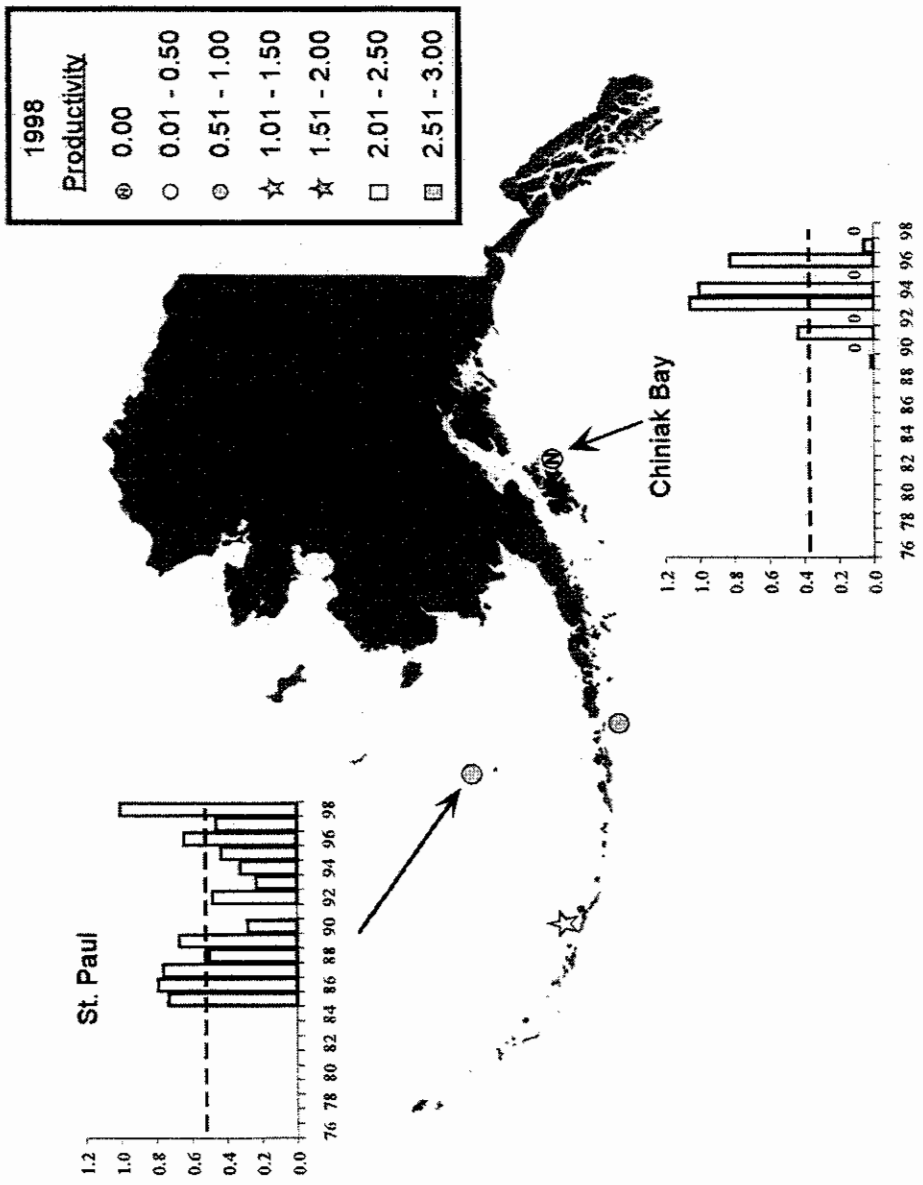

Figure 9. Productivity of red-faced cormorants (large chicks/nest) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Glaucous-winged Gull *(Larus glaucescens)*

Breeding Chronology.--Median hatch dates for gulls were in late June and early July in 1998 (Table 6). Apparently gulls nested slightly earlier at Duck than elsewhere. Nesting was normal or slightly early everywhere except Gull where eggs were laid later in 1998 than in 1997.

Table 6. Hatching chronology of glaucous-winged gulls at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Buldir I.	3 Jul (13)[a]	2 Jul (13)	11 Jul[d] (1)[a]	Williams et al. 1999
Aiktak I.	8 Jul (90)	8 Jul (90)	14 Jul[b] (3)	S. Woodward Unpubl. Data[c]
Gull I.	4 Jul (24)	4 Jul (24)	27 Jun[d] (1)	M. Shultz Unpubl. Data[e]
Duck I.	24 Jun (23)	25 Jun (23)	27 Jun[f] (1)	T. Van Pelt Unpubl. Data[g]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual means
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Mean of annual medians
[e]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998.
[f]Median of annual medians and mean of annual means (mixed)
[g]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.

Productivity.--Hatching success was relatively high in 1998 at Aiktak, in the eastern Aleutians, where nearly 85% of the eggs hatched. Success was near 70% at Gull and St. Lazaria, but ranged only from 56% to 22% elsewhere (Table 7, Fig. 10). All site averages were within normal levels except at Duck where rates were below average.

Populations.--Gulls were counted in plots at St. Lazaria, the Barrens, Aiktak and Kasatochi in 1998. Counts in 1998 were higher than in 1997 at the Barrens and Aiktak but lower in 1998 at Kasatochi and, particularly, St. Lazaria (Fig. 11). Sustained trends were not apparent at any of the sites.

Table 7. Reproductive performance of glaucous-winged gulls at Alaskan sites monitored in 1998.

Site	Hatching Success[a]	No. of Plots	No. of Nests	Reference
Buldir I.	0.22 (0.05)[b]	1	74	Williams et al. 1999
Aiktak I.	0.84 (0.02)	5	107	S. Woodward Unpubl. Data[c]
Semidi Is.	0.46 (0.05)	3	106	Nevins and Adams 1998
Barren Is.	0.56 (0.15)	1	11	A. Kettle Unpubl. Data[d]
Gull I.	0.70 (0.09)	5	24	M. Shultz Unpubl. Data[e]
Duck I.	0.36 (0.29)	4	23	T. Van Pelt Unpubl. Data[f]
Saint Lazaria I.	0.68 (0.05)	4	63	L. Slater Unpubl. Data[g]

[a]Total chicks/Total eggs
[b]Standard deviation in parentheses
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Kettle, A., Alaska Maritime NWR, USFWS. Unpublished Data, 1999.
[e]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998.
[f]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.
[g]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Figure 10. Productivity of glaucous-winged gulls (hatching success) at Alaskan sites monitored in 1998.

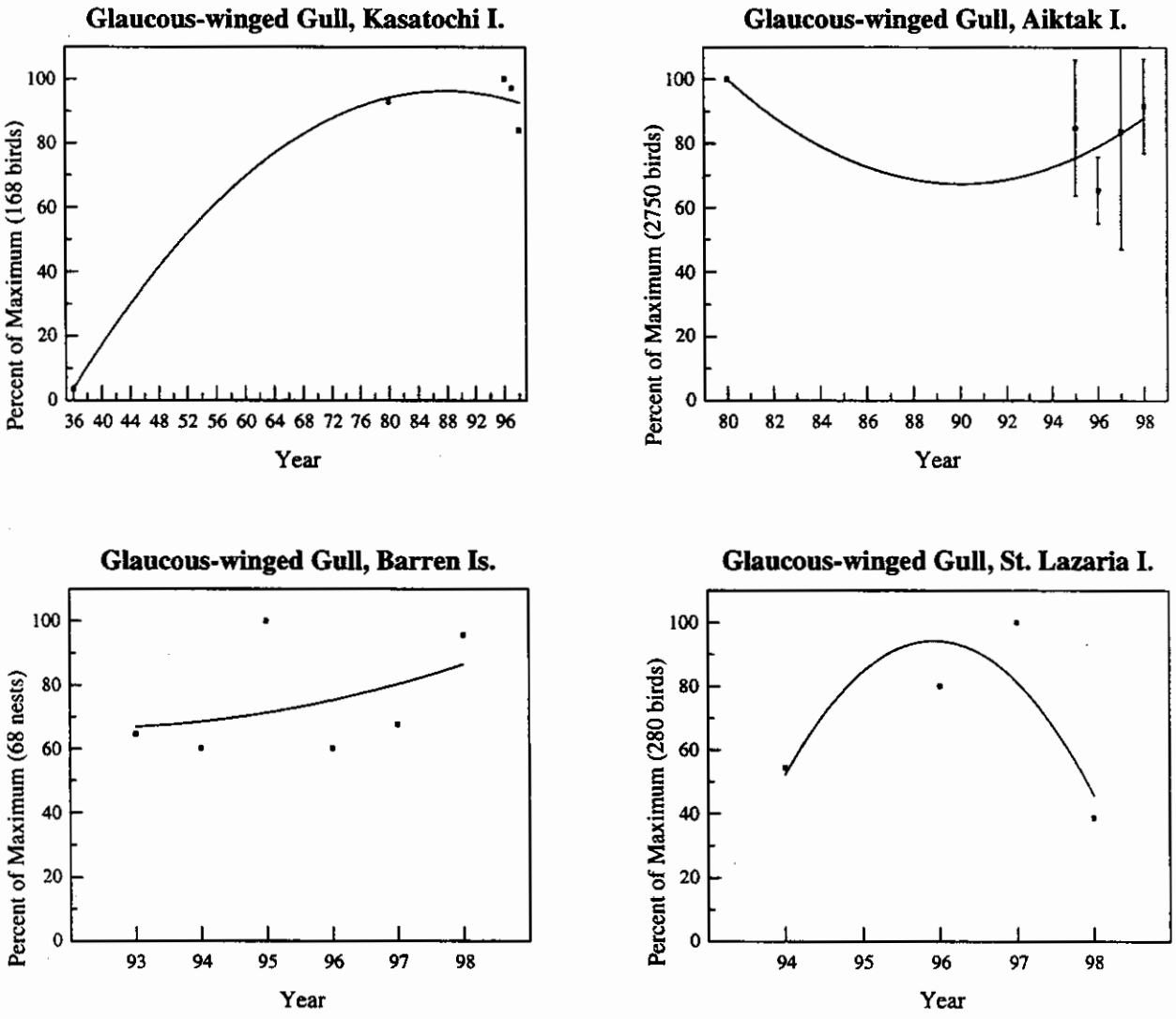

Figure 11. Trends in populations of glaucous-winged gulls at Alaskan sites monitored in 1998. Error bars (90% confidence intervals) are shown for years with multiple counts.

Black-legged Kittiwake (*Rissa tridactyla*)

Breeding Chronology.--Normally, the average hatch date for black-legged kittiwakes is during the last 10 days of July in the Pribilof Islands and at Cape Lisburne in the Chukchi Sea but is earlier in July elsewhere (Table 8). In 1998, nesting was particularly early at Cape Lisburne but was approximately average (within four days) at colonies in the Bering Sea (Little Diomede, Bluff, St. Paul, St. George, Cape Peirce, and Buldir). Hatching was later than normal at most colonies in the Gulf of Alaska, particularly at the Barrens where the average hatch date was more than two weeks later than normal.

Table 8. Hatching chronology of black-legged kittiwakes at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Cape Lisburne	17 Jul (177)[a]	18 Jul (177)	28 Jul[b] (5)[a]	Chance and Chance 1998
Little Diomede I.	21 Jul (379)		17 Jul[b] (2)	Barnes et al. 1999
Bluff		22 Jul (37)	22 Jul[b] (8)	Murphy 1998
Saint Paul I.		21 Jul (199)	24 Jul[c] (14)	Carten and Sommer 1998
Saint George I.		25 Jul (42)	21 Jul[c] (13)	Schindler and Kildaw 1998
Cape Peirce		13 Jul (3)	11 Jul[c] (9)	MacDonald 1999
Buldir I.	5 Jul (160)	6 Jul (160)	6 Jul[b] (4)	Williams et al. 1999
Semidi Is.		31 Jul (38)	15 Jul[c] (8)	Nevins and Adams 1998
Barren Is.	28 Jul (27)		10 Jul[b] (4)	A. Kettle Unpubl. Data[d]
Gull I.	14 Jul (100)	15 Jul (100)	8 Jul[b] (3)	M. Shultz Unpubl. Data[e]
Duck I.	4 Jul (129)	4 Jul (129)	7 Jul[f] (3)	T. Van Pelt Unpubl. Data[g]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual Medians
[c]Mean of annual Means
[d]Kettle, A., Alaska Maritime NWR, USFWS. Unpublished Data, 1999.
[e]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998.
[f]Median of annual medians and mean of annual means (mixed)
[g]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.

Productivity.--Data were gathered at 17 sites in 1998 (Table 9, Fig. 12). Black-legged kittiwakes had below-average success or failed to raise young at five of seven sites in the Gulf of Alaska (Chiniak Bay, Duck, Chiswells, the Barrens, and Semidis). In contrast, success rates in Prince William Sound and Gull were average in 1998. Rates were average or above average at all sites we monitored in the Bering Sea and Chukchi Sea regions (C. Lisburne, Bluff, C. Peirce, St. Paul, St. George, and Buldir).

Populations.--Kittiwake counts at Cape Lisburne in the Chukchi Sea were higher in 1998 than in previous years, but the overall trend between 1987 and 1997 was stable (Fig. 13). At breeding colonies in the Bering Sea where data were available for 1997 and 1998, the latter counts were generally similar or slightly lower, but longer-term trends were either stable or increasing at all sites we surveyed in 1998. In the Gulf of Alaska, counts were similar between 1997 and 1998, except at Duck, where numbers were higher in 1998. Overall trends suggest possible declines in the Semidis and at Duck, but elsewhere in the region populations have been relatively stable or slightly increasing (Fig. 13).

Table 9. Reproductive performance of black-legged kittiwakes at Alaskan sites monitored in 1998.

Site	Nests w/ Chicks Fledged/Nest[a]	No. of Plots	No. of Nests	Reference
Cape Lisburne	0.79 (0.11)[b]	7	223	Chance and Chance 1998
Little Diomede I.	0.88	13	544	Barnes et al. 1999
Bluff	0.41	5	217	Murphy 1998
Nunivak I.	0.68 (0.47)	18	1055	C. Harwood Unpubl. Data[c]
Saint Paul I.	0.44 (0.04)	11	299	Cartin and Sommer 1998
Saint George I.	0.47 (0.09)	4	75	Schindler and Kildaw 1998
Cape Peirce	0.003 (0.00)	13	365	MacDonald 1999
Buldir I.	0.23 (0.02)	13	280	Williams et al. 1999
Kiska I	0.77[d]	1	354	V. Byrd Unpubl. Data[e]
Koniuji I.	0.42[d] (0.06)	10	455	Scharf 1998
Semidi Is.	0.06 (0.03)	8	187	Nevins and Adams 1998
Chiniak Bay	0.00		4,156	D. Irons Unpubl. Data[f]
Barren Is.	0.04 (0.05)	11	210	A. Kettle Unpubl. Data[g]
Gull I.	0.33 (0.25)	10	292	M. Shultz Unpubl. Data[h]
Duck I.	0.00	9	129	T. Van Pelt Unpubl. Data[i]
Chiswell I.	<0.05		~400	D. Roseneau Unpubl. Data[j]
Prince William Sound	0.27		21,128	D. Irons Unpubl. Data[f]

[a]Nests with fledged chick/Total nests
[b]Standard deviation in parentheses
[c]Harwood C., Yukon Delta NWR, USFWS. Unpublished Data, 1999
[d]Value obtained during a short visit to the colony early in the chick-rearing period and so should be considered a maximum estimate of productivity.
[e]Byrd, G. V., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[f]Irons, D. B., Migratory Bird Management, USFWS. Unpublished Data, 1999
[g]Kettle, A, Alaska Maritime NWR, USFWS. Unpublished Data, 1999.
[h]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998.
[i]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.
[j]Roseneau, D. G., Alaska Maritime NWR, USFWS. Unpublished Data 1999.

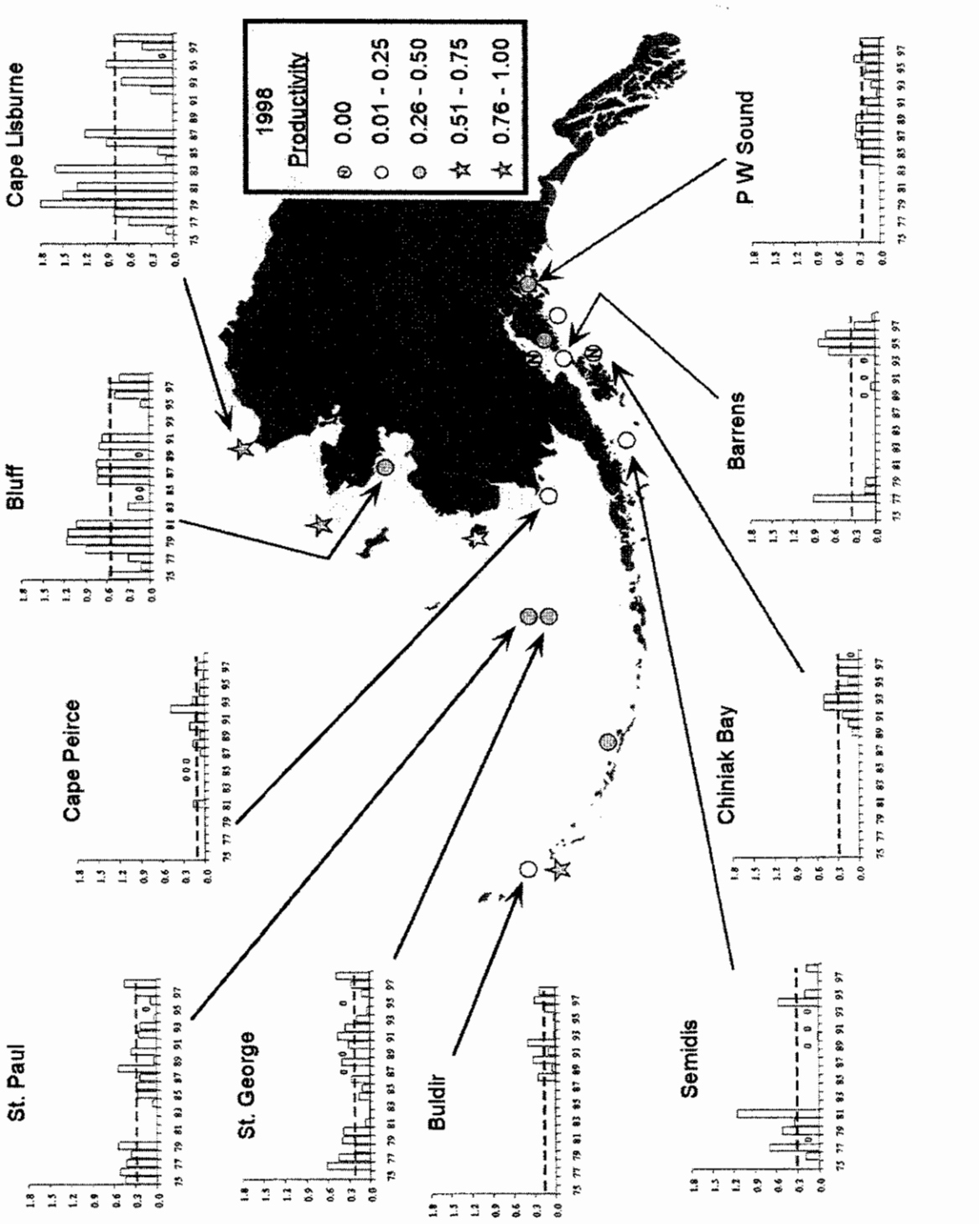

Figure 12. Productivity of black-legged kittiwakes (chicks fledged/nest) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

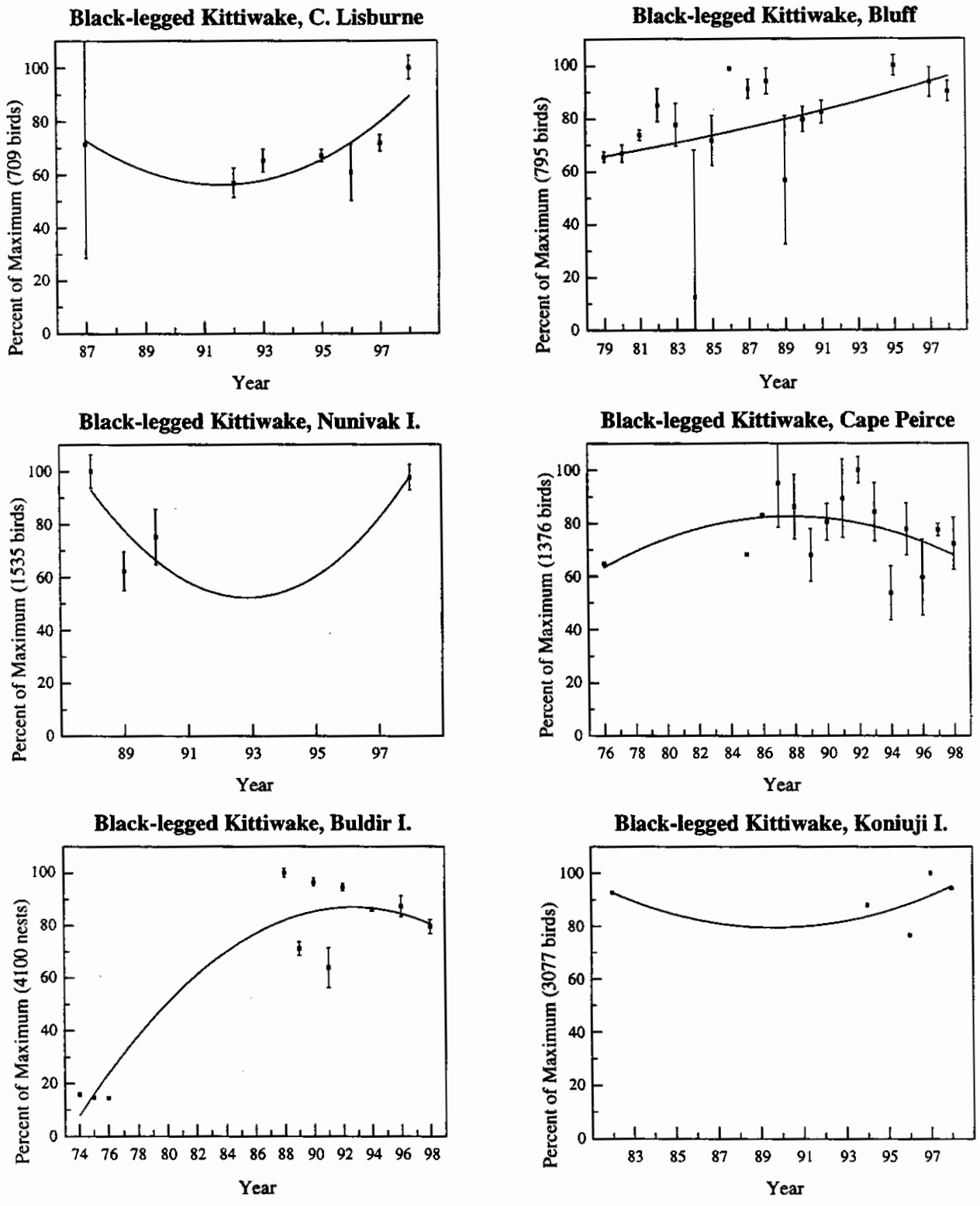

Figure 13. Trends in populations of black-legged kittiwakes at Alaskan sites monitored in 1998. Error bars (90% confidence intervals) are shown for years with multiple counts.

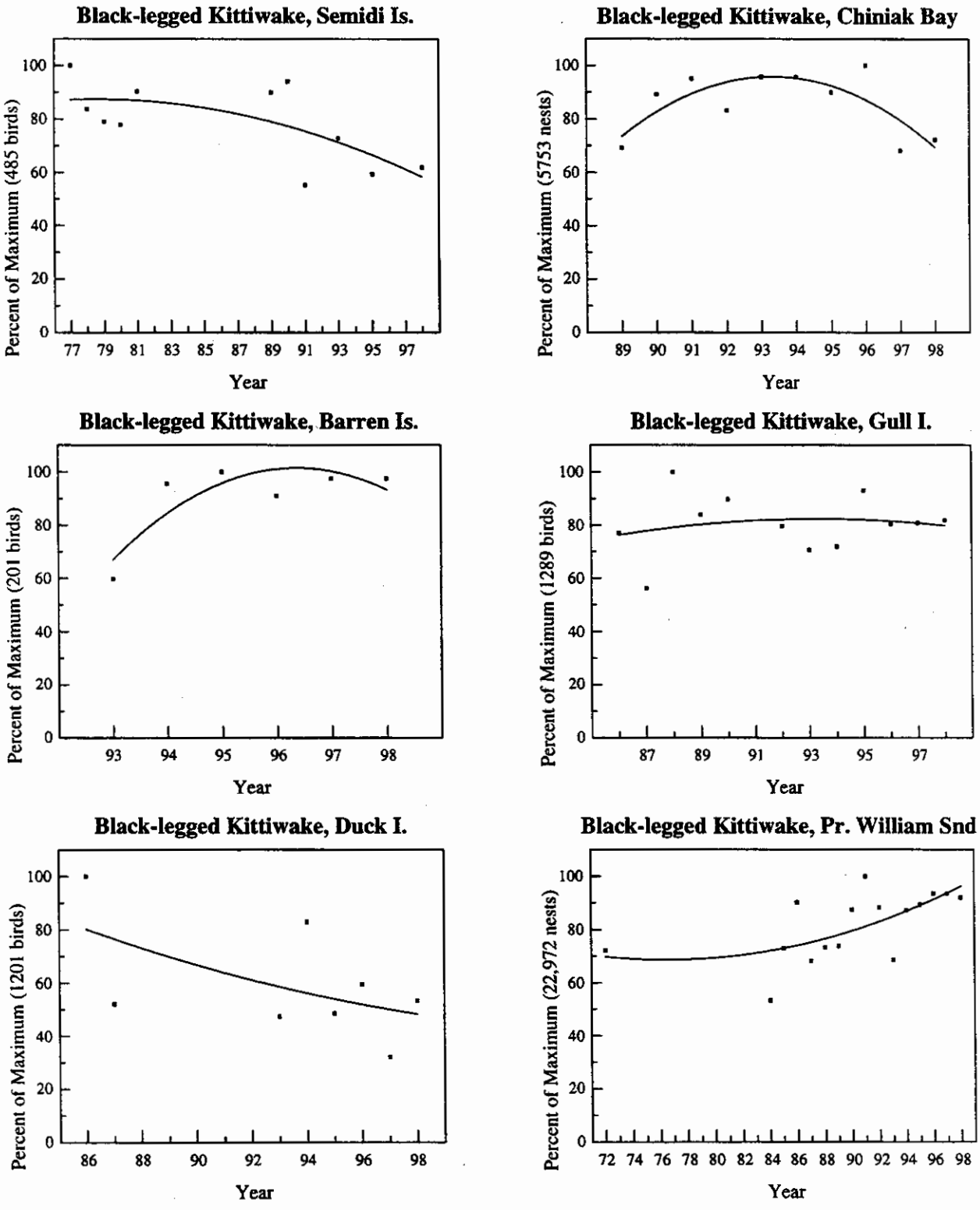

Figure 13. Trends in populations of black-legged kittiwakes at Alaskan sites monitored in 1998 (continued).

Red-legged Kittiwake (*Rissa brevirostris*)

Breeding Chronology.--In 1998 chicks hatched in mid-July at Buldir but 6-10 days later in the Pribilof Islands (St. Paul and St. George) (Table 10). Hatch dates in 1998 were within 3 days of the site averages, but since kittiwakes hatched slightly later than average at Buldir and slightly earlier in the Pribilofs, the difference between the sites was smaller than usual.

Table 10. Hatching chronology of red-legged kittiwakes at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Saint Paul I.		23 Jul (22)[a]	26 Jul[b] (12)[a]	Cartin and Sommer 1998
Saint George I.		19 Jul (103)	21 Jul[b] (16)	Schindler and Kildaw 1998
Buldir I.	12 Jul (62)	13 Jul (62)	10 Jul[c] (10)	Williams et al. 1999

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual means
[c]Mean of annual medians

Productivity.-- In 1998, red-legged kittiwakes experienced average reproductive success at Buldir, but rates were significantly higher than average at St. Paul and St. George Islands in the Pribilof group (Table 11, Fig. 14).

Table 11. Reproductive performance of red-legged kittiwakes at Alaskan sites monitored in 1998.

Site	Nests w/Chicks Fledged/Nest[a]	No. of Plots	No. of Nests	Reference
Saint Paul I.	0.49 (<0.01))[b]	2	35	Carten and Sommer 1998
Saint George I.	0.50 (0.04)	9	207	Schindler and Kildaw 1998
Buldir I.	0.18 (0.07)	5	147	Williams et al. 1999

[a]Nests with fledged chick/Total nests
[b]Standard deviation in parentheses

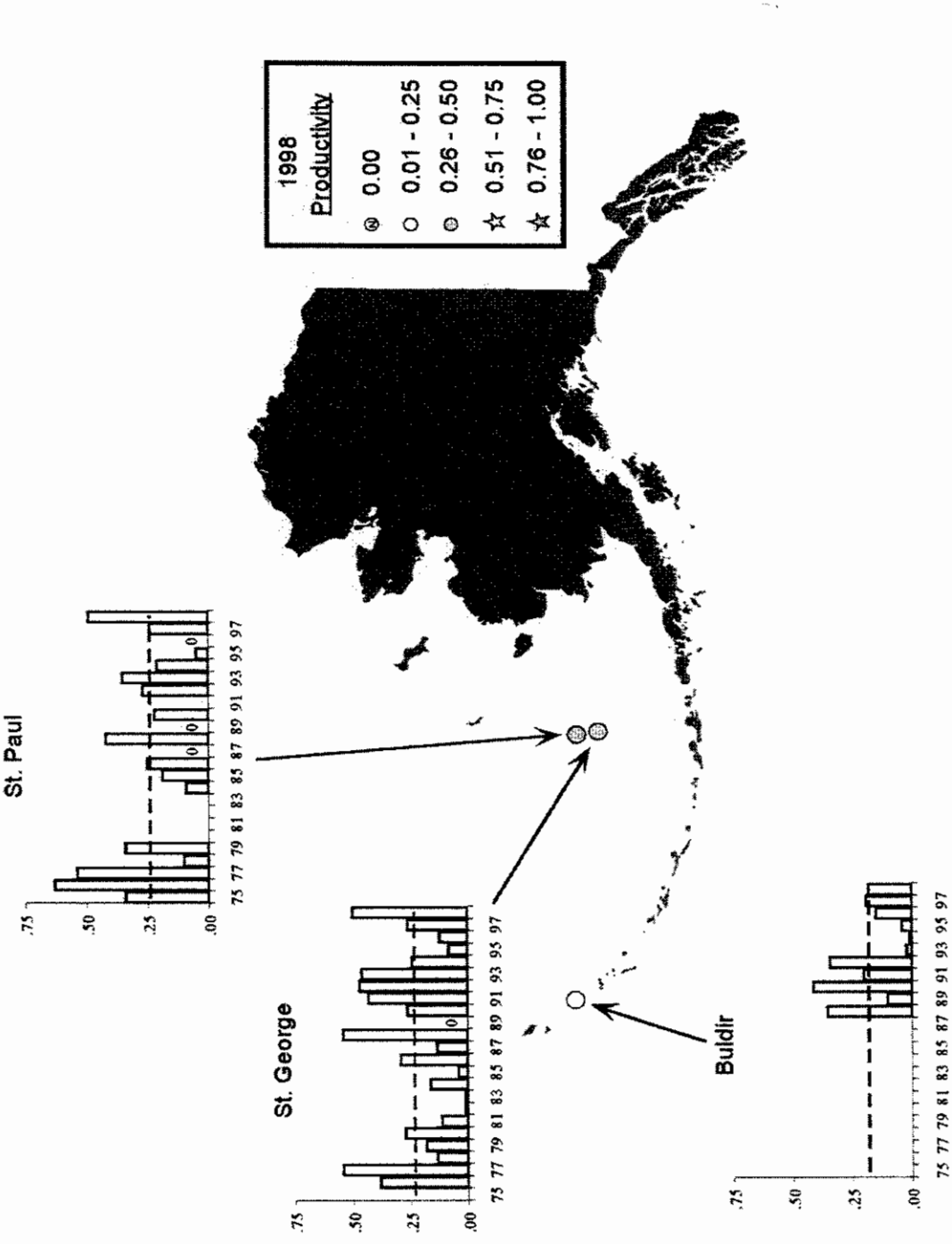

Figure 14. Productivity of red-legged kittiwakes (nests w/chicks fledged/nest) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data.

Populations.--Red-legged kittiwakes were counted at Buldir and Koniuji in 1998. Numbers at Buldir have been relatively stable since 1988 but were higher than in the mid-1970s (Fig. 15). The small colony at Koniuji contained 18 birds and 4 nests when it was discovered in 1996, but numbers had increased to 40 birds and 14 nests in 1998 (Scharf 1998).

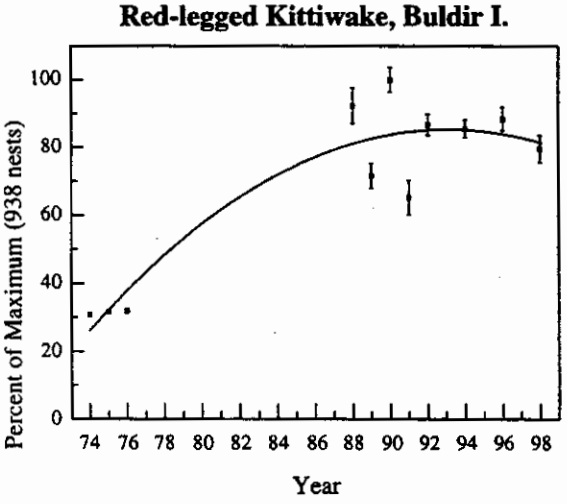

Figure 15. Trends in populations of red-legged kittiwakes at Alaskan sites monitored in 1998. Error bars (90% confidence intervals) are shown for years with multiple counts.

Common Murre (*Uria aalge*)

Breeding Chronology.--Timing of nesting events was earlier (average hatch dates in the last week of July) at colonies on the Alaska mainland coast in the Chukchi and Bering seas (Lisburne, Peirce, and Bluff) than at the offshore sites (means in early to mid-August) in that region in 1998 (Table 12). The median and mean hatch dates varied at Gulf of Alaska colonies from late July at the Semidis to late August at Duck. Compared to site averages for previous years, hatching was slightly early to normal in 1998 at colonies in the Chukchi and northern Bering seas (C. Lisburne, L. Diomede, Bluff). The timing of hatching also was normal at Cape Peirce in the Bering Sea but was more than 10 days later than normal in the Pribilof Islands. In the Gulf of Alaska, the timing of nesting events was nearly normal (within 3 days of average) at the Barrens, Gull, and St. Lazaria but was delayed at the Semidi Islands and at Duck (Table 12).

Productivity.--At most sites in Alaska, annual productivity of common murres normally averages between 55%-70% (Byrd et al. 1993). Productivity was relatively high in 1998 at Cape Lisburne in the Chukchi Sea and at Little Diomede in the northern Bering Sea (Table 13). Rates were normal at Bluff, but farther south in the Bering Sea reproductive success was unusually low at every site but Buldir. In the Gulf of Alaska, productivity was low at the Semidi Islands and at Duck in Cook Inlet, but rates were close to normal elsewhere in this region. Comparing 1998 estimates with site averages from past years, there was a clear pattern of below-average success at colonies in the southern Bering Sea and western Gulf of Alaska (Fig. 16).

Table 12. Hatching chronology of common murres at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Cape Lisburne	29 Jul (21)[a]	28 Jul (21)	2 Aug[b] (3)[a]	Chance and Chance 1998
Little Diomede I.	2 Aug (63)		4 Aug (1)	Barnes et al. 1999
Bluff		26 Jul (231)	27 Jul[d] (2)	Murphy 1998
Saint Paul I.		15 Aug (10)	4 Aug[c] (13)	Cartin and Sommer 1998
Saint George I.		17 Aug (14)	4 Aug[c] (14)	Schindler and Kildaw 1998
Cape Peirce		23 Jul (36)	23 Jul[c] (9)	MacDonald 1999
Semidi Is.		29 Jul (66)	23 Jul[c] (7)	Nevins and Adams 1998
Barren Is.	7 Aug (142)		8 Aug[d] (5)	A. Kettle Unpubl. Data[e]
Gull I.	8 Aug (67)	9 Aug (67)	10 Aug[d] (3)	M. Shultz Unpubl. Data[f]
Duck I.	28 Aug (94)	28 Aug (94)	8 Aug[b] (3)	T. Van Pelt Unpubl. Data[g]
Saint Lazaria I.	10 Aug (39)	12 Aug (39)	14 Aug[c] (4)	L. Slater Unpubl. Data[h]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Median of annual medians and mean of annual means (mixed)
[c]Mean of annual means
[d]Mean of annual medians
[e]Kettle, A., Alaska Maritime NWR, USFWS. Unpublished Data, 1999.
[f]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998.
[g]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.
[h]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Table 13. Reproductive performance of common murres at Alaskan sites monitored in 1998.

Site	Chicks Fledged/ Nest Site[a]	No. of Plots	No. of Nest Sites	Reference
Cape Lisburne	0.75	1	28	Chance and Chance 1998
Little Diomede I.	0.72	11	82	Barnes et al. 1999
Bluff	0.59	7	344	Murphy 1998
Saint Paul I.	0.15 (0.04)[b]	3	68	Carten and Sommer 1998
Saint George I.	0.21 (0.04)	3	39	Schindler and Kildaw 1998
Cape Peirce	0.18 (0.11)	7	152	MacDonald 1999
Buldir I.	0.55 (0.15)	1	11	Williams et al. 1999
Kasatochi I.	0.00	1	<20	Scharf 1998
Aiktak I.	0.00			S. Woodward Unpubl. Data[c]
Semidi Is.	0.21 (0.05)	13	180	Nevins and Adams 1998
Barren Is.	0.59 (0.31)	10	256	A. Kettle Unpubl. Data[d]
Gull I.	0.75 (0.05)	5	74	M. Shultz Unpubl. Data[e]
Duck I.	0.01 (0.02)	6	94	T. Van Pelt Unpubl. Data[f]
Saint Lazaria I.	0.53 (0.11)	4	57	L. Slater Unpubl. Data[g]

[a]Since murres do not build nests, nest sites were defined as sites where eggs were laid.
[b]Standard deviation in parentheses
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Kettle, A., Alaska Maritime NWR, USFWS. Unpublished Data, 1999.
[e]Shultz, M., Biol. Res. Div., USGS. Unpublished Data, 1998.
[f]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.
[g]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

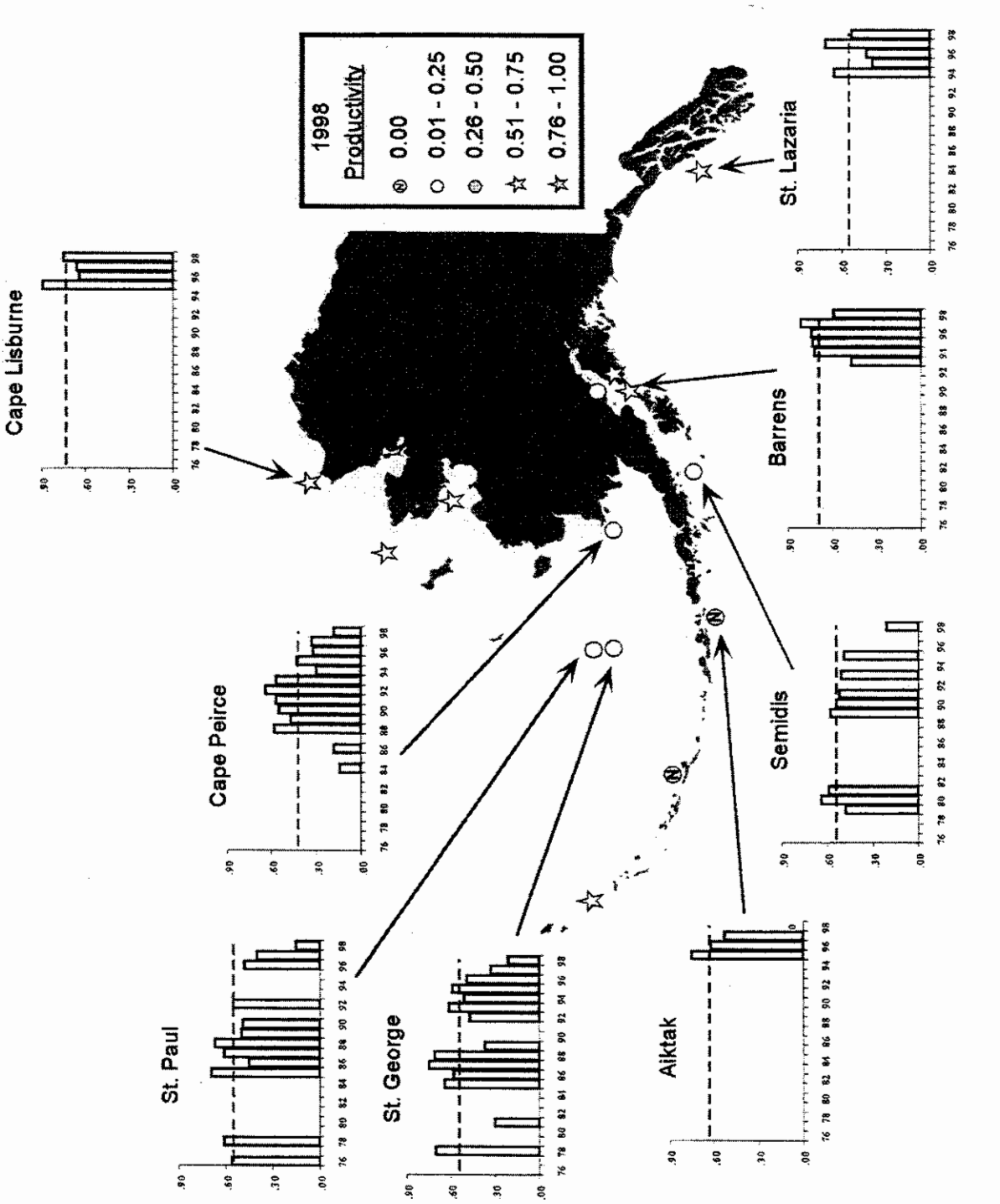

Figure 16. Productivity of common murres (chicks fledged/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Populations.--At sites where counts of murres are made from the water, it is difficult to accurately assign every individual to species. As a result, common and thick-billed murres are combined at these sites for population trend analysis (Fig. 17). In 1998, murres were counted at 10 locations with historical data and at four additional sites (Little Diomede, Kasatochi, Ulak, Kiska) where too few years of data are available to describe trends. At Cape Lisburne in the Chukchi Sea, numbers of murres on plots were similar in 1998 and 1997, but the overall trend suggests an increasing population (Fig. 17). In the Bering Sea, counts in 1998 were lower than 1997 at three of four sites where trend data were available and also at Kasatochi and Ulak where numbers were far lower than in 1997 (Scharf 1998). As indicated above, productivity was unusually low in 1998 at many of these sites. Reduced numbers of birds at nesting ledges is sometimes associated with years of low productivity and is not necessarily indicative of population declines. Regardless, there were no indications of sustained declining trends at most of the Bering sea colonies we monitored in 1998 (Fig. 17). The exception was at Aiktak where a single count in 1980 was much higher than subsequent counts. In the Gulf of Alaska, counts in 1998 were similar to, or higher, than previous counts except at Duck in Cook Inlet where the population continues to decline.

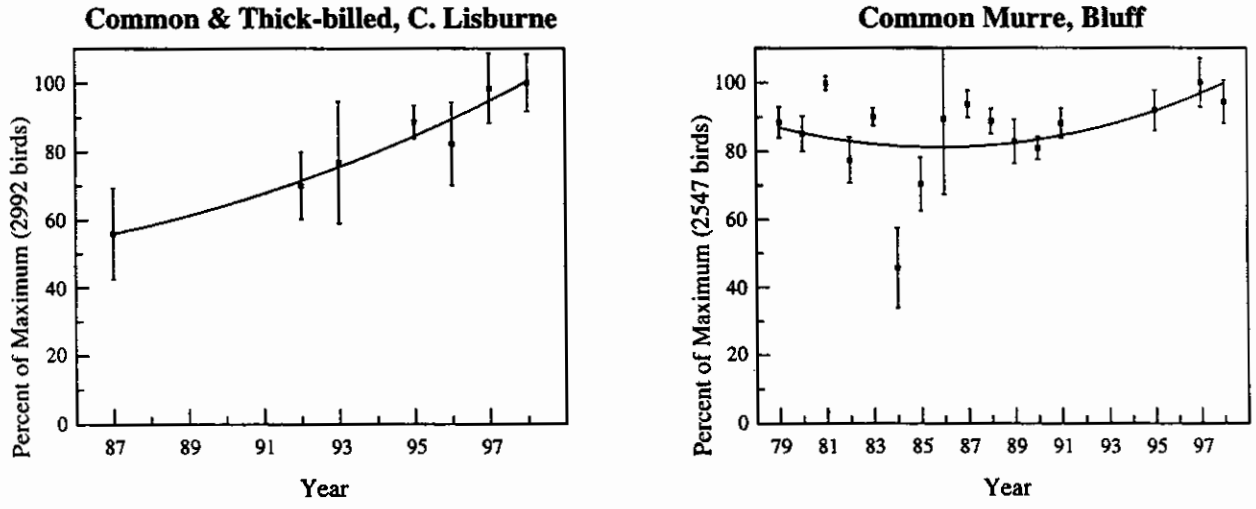

Figure 17. Trends in populations of murres at Alaskan sites monitored in 1998. Error bars (90% confidence intervals) are shown for years with multiple counts.

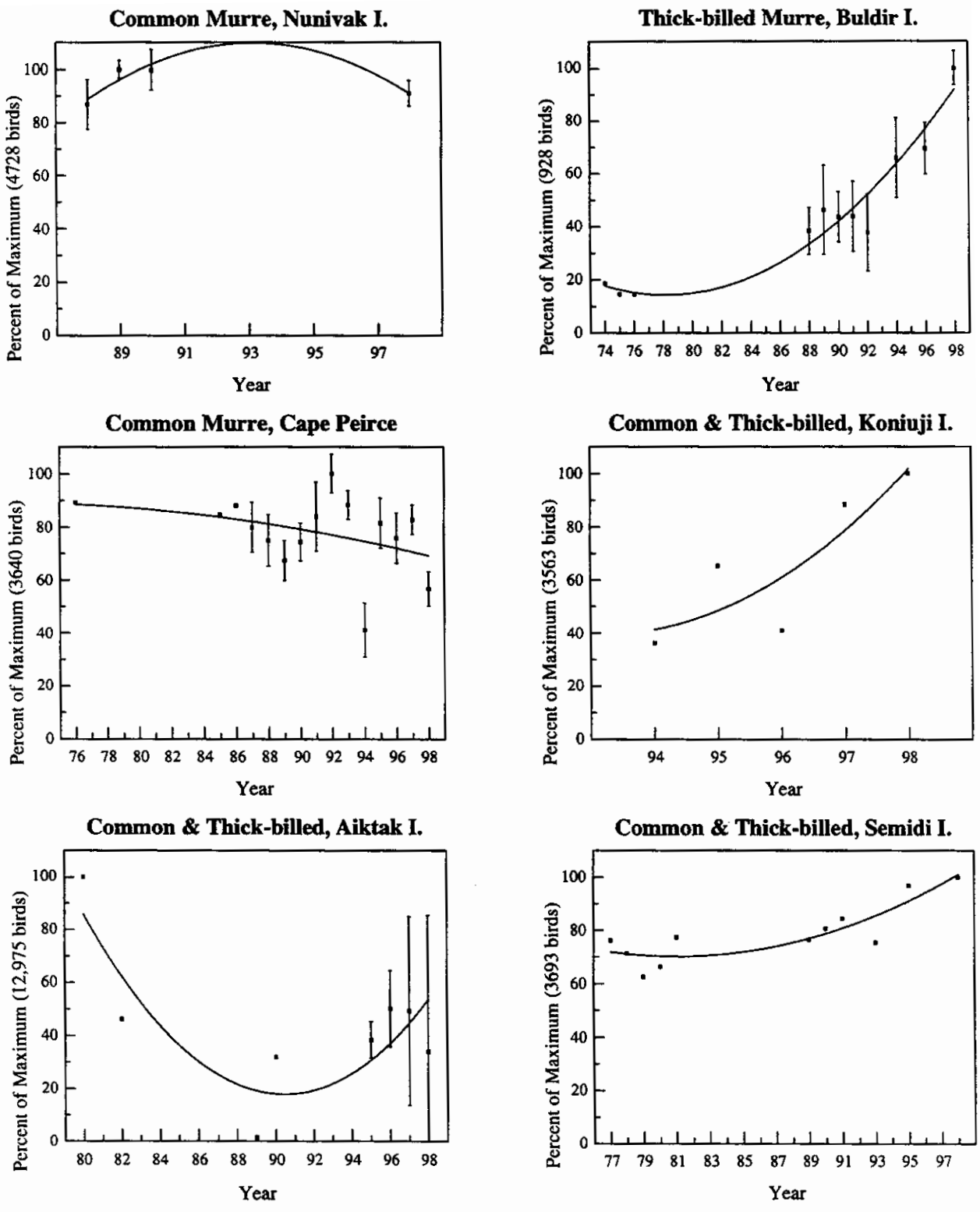

Figure 17. Trends in populations of murres at Alaskan sites monitored in 1998 (continued). Error bars (90% confidence intervals) are shown for years with multiple counts.

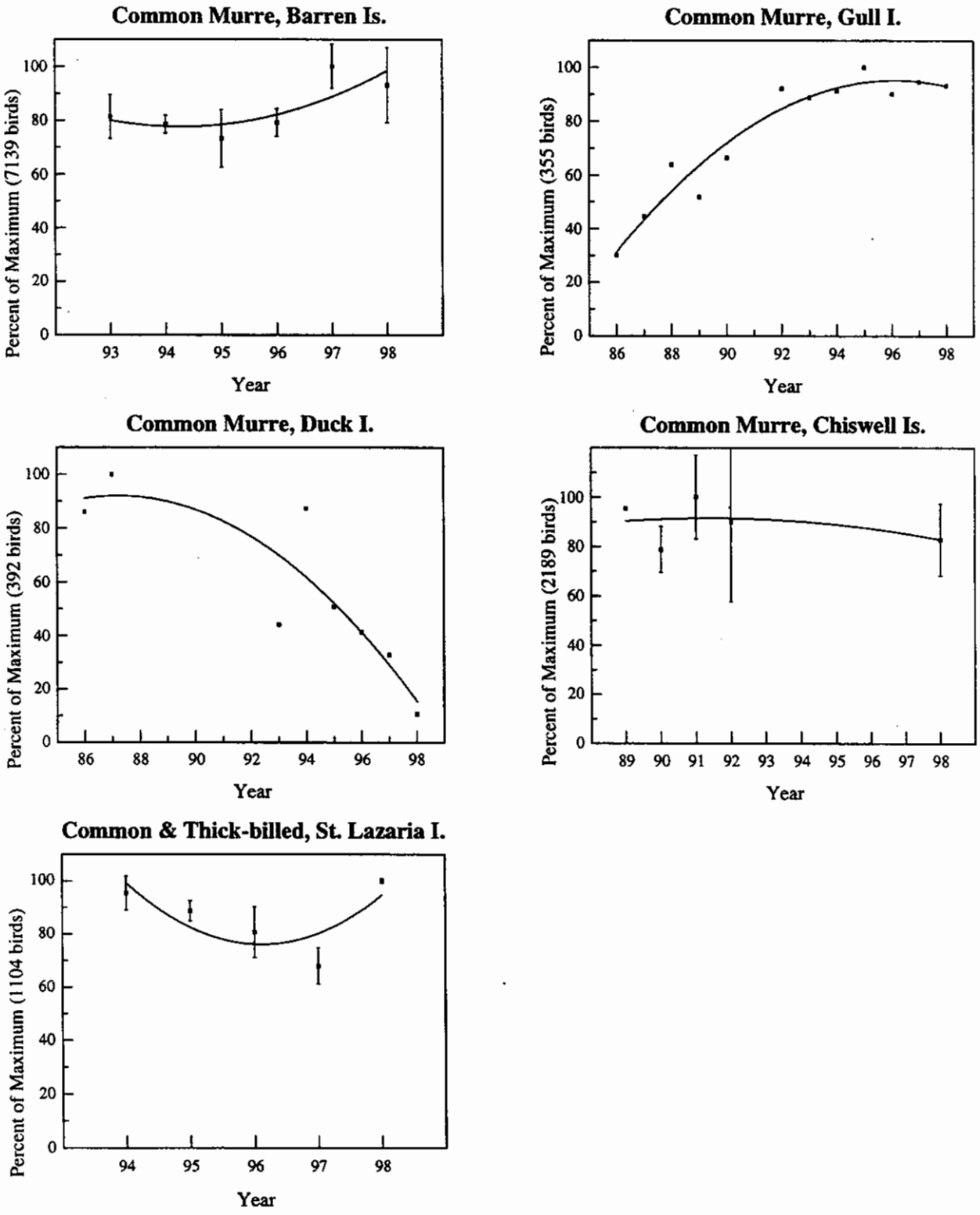

Figure 17. Trends in populations of murres at Alaskan sites monitored in 1998 (continued). Error bars (90% confidence intervals) are shown for years with multiple counts.

Thick-billed Murre (*Uria lomvia*)

Breeding Chronology.--Thick-billed murre chicks hatched at Cape Lisburne in the Chukchi Sea about 1 week earlier than normal in 1998 (Table 14). At colonies in the Bering Sea, hatching was about 10 days late in the Pribilof Islands (St. George and St. Paul) but was nearly normal at Little Diomede and Buldir. Timing also was normal at St. Lazaria in the Gulf of Alaska.

Table 14. Hatching chronology of thick-billed murres at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Cape Lisburne	23 Jul (222)[a]	24 Jul (222)	30 Jul[b] (3)[a]	Chance and Chance 1998
L. Diomede I.	3 Aug (84)		5 Aug (1)	Barnes et al. 1999
Saint Paul I.		14 Aug (66)	4 Aug[b] (14)	Carten and Sommer 1998
Saint George I.		9 Aug (92)	31 Jul[b] (16)	Schindler and Kildaw 1998
Buldir I.	15 Jul (56)	16 Jul (56)	17 Jul[c] (10)	Williams et al. 1999
Saint Lazaria I.	10 Aug (33)	12 Aug (33)	12 Aug[b] (4)	L. Slater Unpubl. Data[d]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual means
[c]Mean of annual medians
[d]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Productivity.--Annual productivity averages for thick-billed murres tend to be slightly lower than for common murres at most sites in Alaska, typically ranging between approximately 40% and 70% (Byrd et al. 1993). Rates of success in 1998 (Table 15, Fig. 18) were average at sites in the Chukchi (C. Lisburne) and northern Bering (Little Diomede) seas. In contrast, thick-billed murres failed to produce any young at colonies in the central and eastern Aleutians (Aiktak and Kasatochi) and had below average success at other Bering Sea sites except St. George. At Gulf of Alaska sites rates were relatively low in 1998.

Table 15. Reproductive performance of thick-billed murres at Alaskan sites monitored in 1998.

Site	Chicks Fledged/ Nest Site[a]	No. of Plots	No. of Nest Sites	Reference
Cape Lisburne	0.73 (0.08)[b]	10	287	Chance and Chance 1998
Little Diomede I.	0.77	10	106	Barnes et al. 1999
Saint Paul I.	0.22 (0.05)	10	246	Carten and Sommer 1998
Saint George I.	0.49 (0.06)	7	160	Schindler and Kildaw 1998
Buldir I.	0.47 (0.06)	9	270	Williams et al. 1999
Kasatochi I.	0.00		<20	Scharf 1998
Aiktak I.	0.00			S. Woodward Unpubl. Data[c]
Semidi Is.	0.24 (0.06)	1	59	Nevins and Adams 1998
Saint Lazaria I.	0.34 (0.14)	4	58	L. Slater Unpubl. Data[d]

[a]Since murres do not build nests, nest sites were defined as sites where eggs were laid.
[b]Standard deviation in parentheses
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Populations.--Thick-billed murres were included with common murres at all sites where they were counted in 1998 (Fig. 17) except at Buldir. There numbers were higher in 1998 than previously, and the increasing trend since the mid-1970s is continuing (Fig. 17).

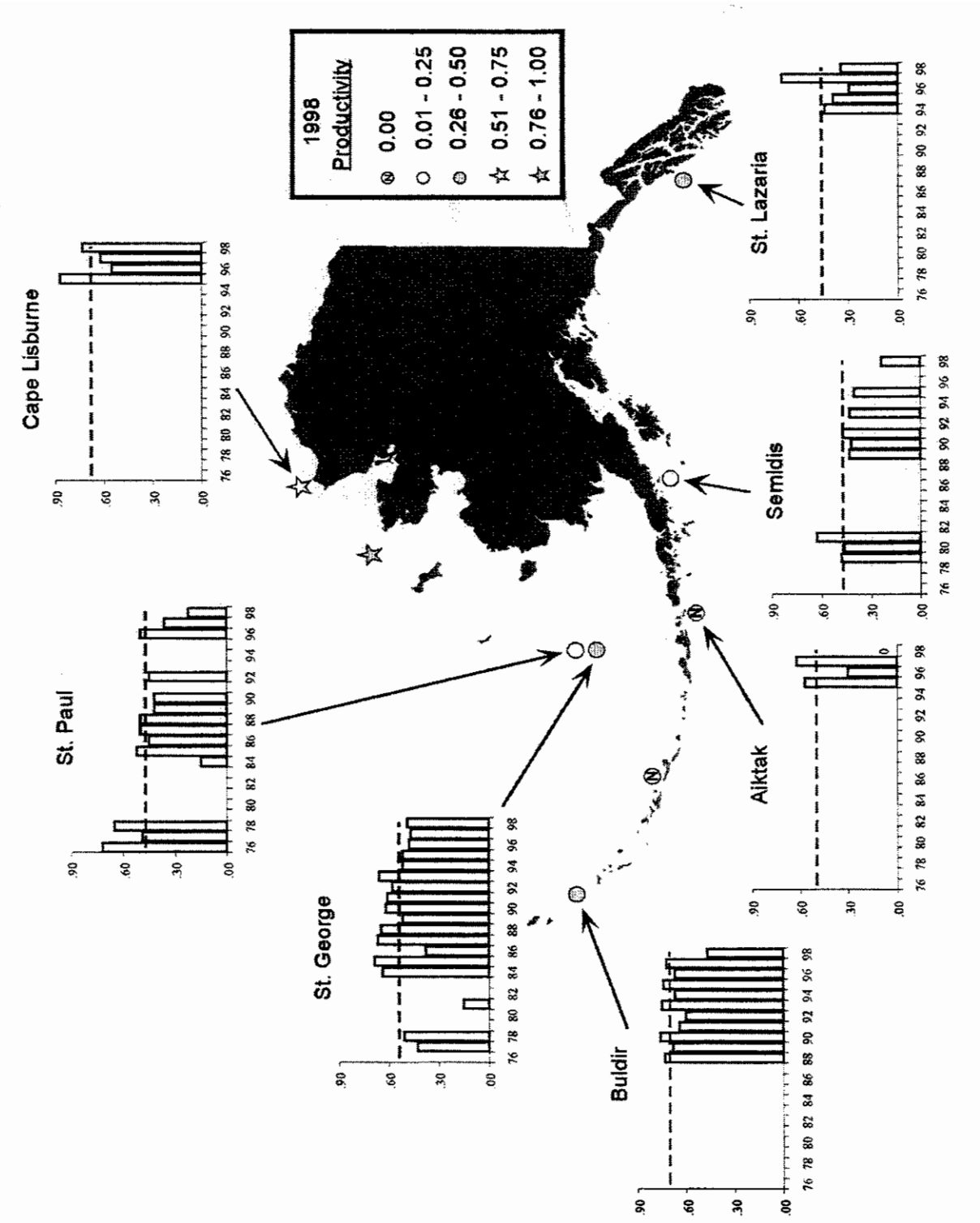

Figure 18. Productivity of thick-billed murres (chicks fledged/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Parakeet Auklet (*Cyclorrhynchus psittacula*)

Breeding Chronology.--In 1998, the peak of hatching for parakeet auklet eggs was about 11 days later than average at Buldir in the western Aleutian Islands, the only site where we could monitor this species (Table 16).

Table 16. Hatching chronology of auklets at Alaskan sites monitored in 1998. Long-term average was calculated as the mean of the annual median hatch dates.

Site/Species	Median	Mean	Long-term Average	Reference
Parakeet Auklet				
Buldir I.	14 Jul (34)[a]	14 Jul (34)	3 Jul (7)[a]	Williams et al. 1999
Least Auklet				
Little Diomede I.	12 Aug (7)		2 Aug (2)	Barnes et al. 1999
Buldir I.	29 Jun (44)	30 Jun (44)	27 Jun (9)	Williams et al. 1999
Kasatochi I.	3 Jul (65)	3 Jul (65)	27 Jun (2)	Scharf 1998
Crested Auklet				
Little Diomede I.	12 Aug (12)		8 Aug (2)	Barnes et al. 1999
Buldir I.	7 Jul (10)	5 Jul (10)	27 Jun (9)	Williams et al. 1999
Kasatochi I.	3 Jul (72)	5 Jul (72)	1 Jul (2)	Scharf 1998
Whiskered Auklet				
Buldir I.	19 Jun (61)	23 Jun (61)	21 Jun (9)	Williams et al. 1999

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.

Productivity.-- In 1998, productivity was 0.61 chicks fledged per nest at Buldir (Table 17, Fig. 19), similar to the long-term average there (0.58 chicks fledged per egg, n = 7 years). Productivity at the Semidis was 0.25 chicks fledged per nest. We do not have data from previous years for this species in the Semidis, but productivity there was less than half that at Buldir in 1998.

Populations.--We currently know of no method of monitoring populations of parakeet auklets. Research is needed to develop a method that could be employed at annual monitoring sites in the Aleutian, Pribilof, and Semidi islands.

Table 17. Reproductive performance of auklets at Alaskan sites monitored in 1998.

Site/Species	Chicks Fledged/ Nest Site[a]	No. of Nest Sites	Reference
Parakeet			
Buldir I.	0.61 (0.06)[b]	71	Williams et al. 1999
Semidi Is.	0.25 (0.04)	12	Nevins and Adams 1998
Least			
Little Diomede I.	0.18	22	Barnes et al. 1999
Buldir I.	0.45 (0.06)	76	Williams et al. 1999
Kasatochi I	0.49 (0.05)	95	Scharf 1998
Crested			
Little Diomede I.	0.46	26	Barnes et al. 1999
Buldir I.	0.76 (0.06)	70	Williams et al. 1999
Kasatochi I.	0.66 (0.05)	104	Scharf 1998
Whiskered			
Buldir I.	0.53 (0.06)	78	Williams et al. 1999

[a]Nest site is defined as a site where an egg was laid.
[b]Standard deviation in parentheses.

Figure 19. Productivity of parakeet auklets (chicks fledged/egg) at Alaskan sites monitored in 1998.

Least Auklet (*Aethia pusilla*)

Breeding Chronology.---The average dates of hatching for least auklets in the Aleutians were three to six days later than average (27 June) in 1998 (Table 16). Typically, timing of hatching is about one month later in the northern Bering Sea than in the Aleutians, but the hatch was even later in 1998 than in two previous years at Little Diomede.

Productivity.--Along with late hatching, least auklets had just slightly below-average reproductive success in 1998 (45%-49%) at Kasatochi and Buldir in the Aleutian Islands (Table 17, Fig. 20). Farther north in the Bering Sea at Little Diomede, success in 1998 was very low (18%).

Populations.--In 1998, populations were monitored only at Kasatochi in the Aleutian Islands. Fewer birds were seen than in 1997, and there appears to be a declining trend since 1991 (Fig. 21).

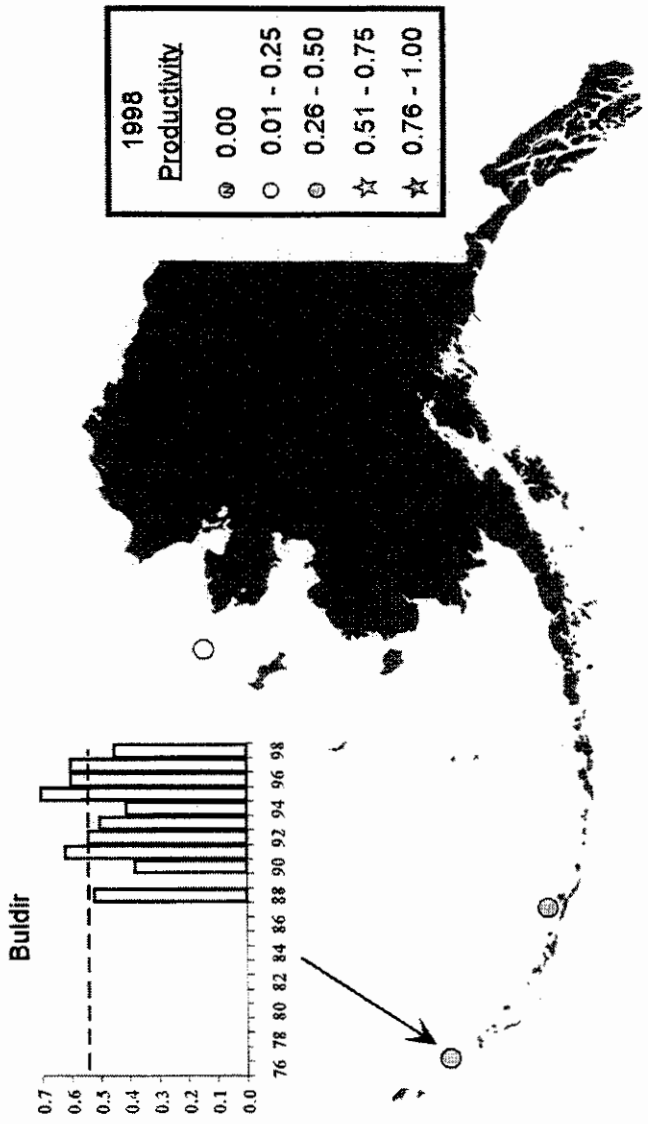

Figure 20. Productivity of least auklets (chicks fledged/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

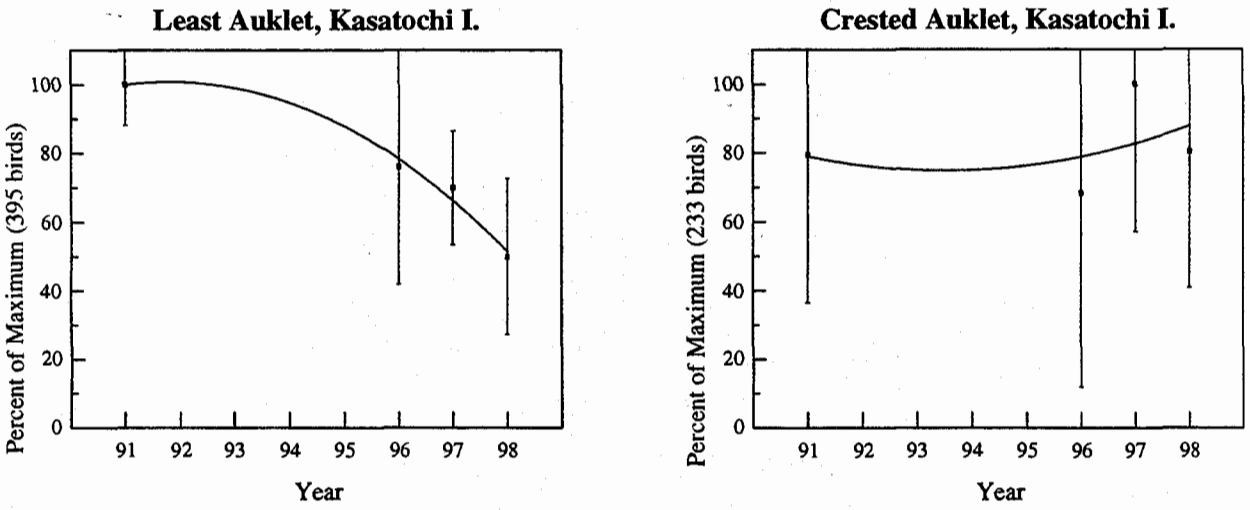

Figure 21. Trends in populations of auklets at Alaskan sites monitored in 1998. Error bars (90% confidence intervals) are shown for years with multiple counts.

Crested Auklet (*Aethia cristatella*)

Breeding Chronology.--The average date of hatching for crested auklets in 1998 was nearly normal (2-4 days later than average) at Kasatochi and Little Diomede, but hatching was delayed substantially (8-10 days) at Buldir in the western Aleutians (Table 16).

Productivity.--Despite delays in the onset of nesting, crested auklets had normal or slightly higher than average rates of success at Buldir (Table 17, Fig. 22) and Kasatochi (average for two prior years = 0.65 chicks fledged per pair). Although productivity in 1998 was lower at Little Diomede than in the Aleutians, the rate was similar to the average of past years at Little Diomede (Barnes et al. 1999).

Populations.--In 1998, populations were monitored only at Kasatochi in the Aleutian Islands, where there has been no obvious population trend since the early 1990s (Fig. 21).

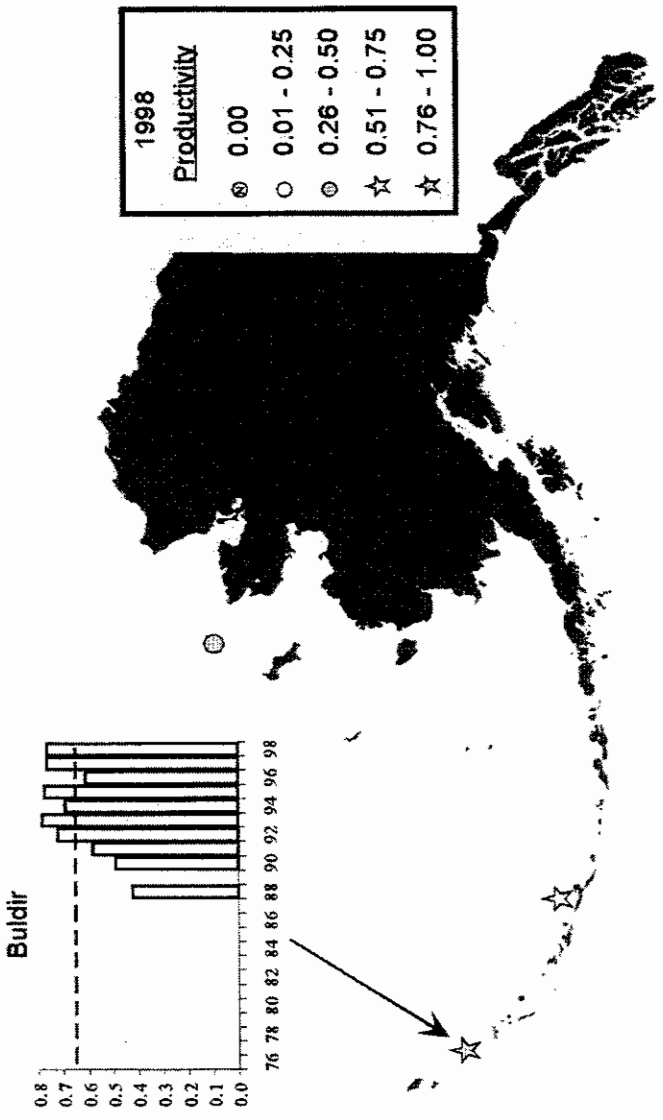

Figure 22. Productivity of crested auklets (chicks fledged/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Whiskered Auklet (*Aethia pygmaea*)

Breeding Chronology.--At Buldir, the only site where we monitor the species, whiskered auklets hatched at about average dates in 1998 (Table 16).

Productivity.--In 1998, about 0.53 chicks fledged per pair at Buldir (Table 17), a rate that is lower than the long-term average there (0.63, n = 8 years, J. Williams Unpubl. Data).

Populations.--Although experiments are being conducted with capture-recapture methods (J. Williams and I. Jones, Unpubl. Data), no accepted approach for monitoring population trends has yet been developed. Once methods are developed, it might be possible to monitor whiskered auklets at Buldir , Kasatochi/Koniuji/Ulak, and at several less-frequently visited sites.

Rhinoceros Auklet (*Cerorhinca monocerata*)

Breeding Chronology.--In 1998, the average laying date for rhinoceros auklet eggs was 17 May at the Semidis (Nevins and Adams 1998), earlier than in the mid- to late 1970s when similar data were available. The mean hatch was 2 July in 1998 (Table 18). At St. Lazaria in 1998, hatching was similar to the average of past years (3 days earlier).

Table 18. Hatching chronology of rhinoceros auklets at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Semidi Is.		2 Jul (24)[a]	N/A	Nevins and Adams 1998
St. Lazaria I.[b]	16 Jun (33)	16 Jun (33)	19 Jun[c] (3)[a]	L. Slater Unpubl. Data[d]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Chronology calculated from formula developed by Leschner 1976 {based on mean chick mass at hatching + constant [X g gain/da]}
[c]Mean of annual means
[d]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Productivity.--Productivity at St. Lazaria and the Semidis was similar in 1998 (Table 19, Fig. 23). Prior data were not available for St. Lazaria, but at the Semidis, the 1998 estimate was similar to 1976, but much higher than the value recorded in 1977 there (Nevins and Adams 1998).

Table 19. Reproductive performance of rhinoceros auklets at Alaskan sites monitored in 1998.

Site	Chicks Fledged/ Egg	No. of Eggs	Reference
Semidi Is.	0.59 (0.08)[a]	34	Nevins and Adams 1998
St. Lazaria I.	0.55 (0.09)	31	L. Slater Unpubl. Data[b]

[a]Standard deviation in parentheses.
[b]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

Figure 23. Productivity of rhinoceros auklets (chicks/egg) at Alaskan sites monitored in 1998.

Populations.--Nest burrow entrances were counted at a study area in the Semidis in 1998 for the first time since 1976, and numbers increased from 566 to 1437, a 250% change (Nevins and Adams 1998). An increase also occurred at St. Lazaria between 1994 and 1997, but numbers were similar to the 1997 total in 1998 (Fig. 24).

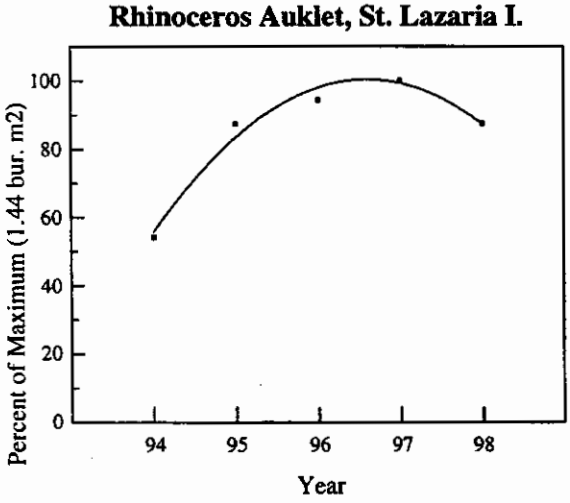

Figure 24. Trends in populations of rhinoceros auklets at Alaskan sites monitored in 1998.

Tufted Puffin (*Fratercula cirrhata*)

Breeding Chronology.--Hatch dates for tufted puffins were obtained only for two sites in 1998; Buldir in the western Aleutians and the Barrens in the Gulf of Alaska. Timing was 4-5 days earlier than average at Buldir but six days later at the Barrens (A. Kettle, Unpubl. Data). Apparently, hatching is typically earlier at Buldir than at the Barrens (Table 20).

Table 20. Hatching chronology of tufted puffins at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Buldir I.	9 Jul (21)[a]	8 Jul (21)	13 Jul[b] (9)[a]	Williams et al. 1999
Barren Is.		31 Jul (41)	25 Jul[c] (4)	A. Kettle Unpubl. Data[d]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual medians
[c]Mean of annual means
[d]Kettle, A., Alaska Maritime NWR, USFWS. Unpublished Data, 1999.

Productivity.-- In a review of available data on productivity of tufted puffins, Byrd et al. (1993) indicated that the average was 0.46 fledglings per egg. At our monitoring sites, rates of reproductive success varied substantially among sites in 1998. At Buldir and the Barrens, tufted puffins had substantially lower than average success. In contrast, success was nearly average at Aiktak, and slightly above average at the Semidis and at St. Lazaria in 1998 (Table 21, Fig. 25).

Table 21. Reproductive performance of tufted puffins at Alaskan sites monitored in 1998.

Site	Chicks Fledged[a]/Egg	No. of Eggs	Reference
Buldir I.	0.17 (0.05)[b]	52	Williams et al. 1999
Aiktak I.	0.32 (0.06)	63	S. Woodward Unpubl. Data[c]
Semidi Is.	0.63 (0.17)	8	Nevins and Adams 1998
Barren Is.	0.16 (0.10)	55	A. Kettle Unpubl. Data[d]
Saint Lazaria I.	0.68 (0.32)	37	L. Slater Unpubl. Data[e]

[a]Fledged chick defined as being still alive at last check in August or September.
[b]Standard deviation in parentheses.
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Kettle, A., Alaska Maritime NWR, USFWS. Unpublished Data, 1999.
[e]Slater, L., Alaska Maritime NWR, USFWS. Unpublished Data, 1999

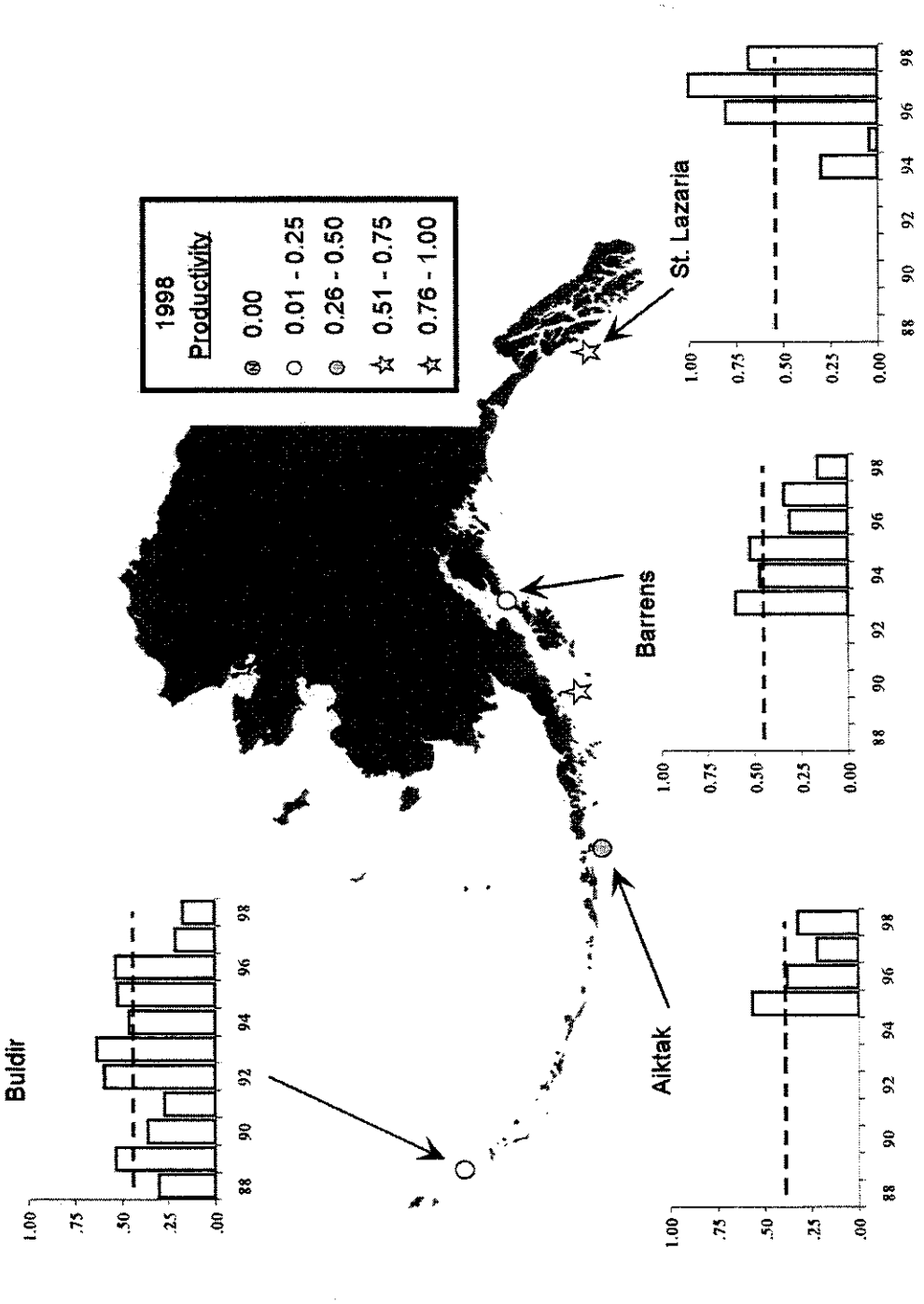

Figure 25. Productivity of tufted puffins (chicks/egg) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Populations.--Plots for monitoring changes in numbers of nesting tufted puffins have been set up at the following annual monitoring sites: Buldir, Ulak, Aiktak, the Semidis, the Barrens, and St. Lazaria. In 1998, plots were surveyed at Ulak, Aiktak, the Barrens, and St. Lazaria. Numbers of burrows have increased in the study plots at Ulak over the past three years (Scharf 1998). Counts at Aiktak (Fig. 26) and the Barrens (A. Kettle Unpubl. Data) suggest fairly stable populations, but burrow counts suggest a possible decline at St. Lazaria.

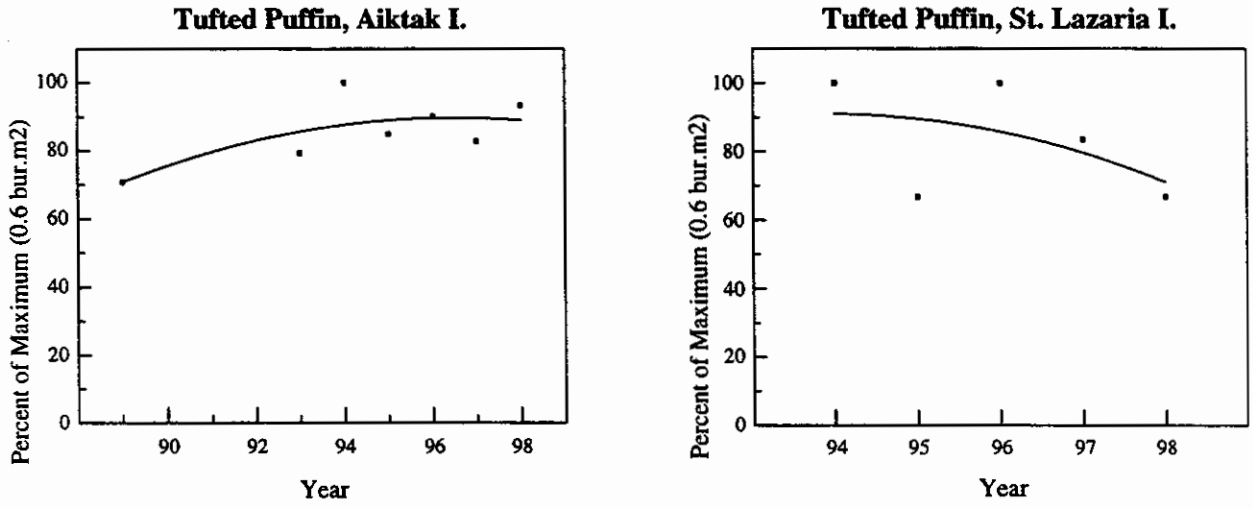

Figure 26. Trends in populations of tufted puffins at Alaskan sites monitored in 1998.

Horned Puffin (*Fratercula corniculata*)

Breeding Chronology.--The peak hatch occurred during the last week in July at both Buldir and Duck but was during the first week of August at Aiktak in 1998 (Table 22). These dates were similar to the average for past years at Buldir and Duck. This is the first year data were available for Aiktak .

Table 22. Hatching chronology of horned puffins at Alaskan sites monitored in 1998.

Site	Median	Mean	Long-term Average	Reference
Buldir I.	23 Jul (16)[a]	20 Jul (16)	23 Jul[b] (10)[a]	Williams et al. 1999
Aiktak I.	3 Aug (5)	6 Aug (5)	N/A	S. Woodward Unpubl. Data[c]
Duck I.	26 Jul (46)	28 Jul (46)	25 Jul[b] (2)	T. Van Pelt Unpubl. Data[d]

[a]Sample size in parentheses represents the number of nest sites used to calculate the mean or median hatch date and the number of years used to calculate the long-term average. Current year not included in long-term average.
[b]Mean of annual medians
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.

Productivity.--. The average for 18 estimates of productivity for various sites in Alaska was 0.57 fledglings per egg (Byrd et al. 1993). Compared to this, success rates were below average at Buldir and Duck in 1998 (Table 23), but puffins at Aiktak had slightly higher than average success (Fig. 27). The only parameter on horned puffins in the Semidis was hatch success, and the rate recorded in 1998 was much lower than the average for Alaska (Byrd et al. 1993).

Table 23. Reproductive performance of horned puffins at Alaskan sites monitored in 1998.

Site	Chicks Fledged[a]/Egg	Hatch Success	No. of Eggs	Reference
Buldir I.	0.36 (0.08)[b]		39	Williams et al. 1999
Aiktak I.	0.67 (0.17)		9	S. Woodward Unpubl. Data[c]
Semidi Is.		0.33	9	Nevins and Adams 1998
Duck I.	0.25		48	T. Van Pelt Unpubl. Data[d]

[a]Fledged chick defined as being still alive at last check in August or September.
[b]Standard deviation in parentheses
[c]Woodward, S., Alaska Maritime NWR, USFWS. Unpublished Data, 1999
[d]Van Pelt, T., Biol. Res. Div., USGS. Unpublished Data, 1999.

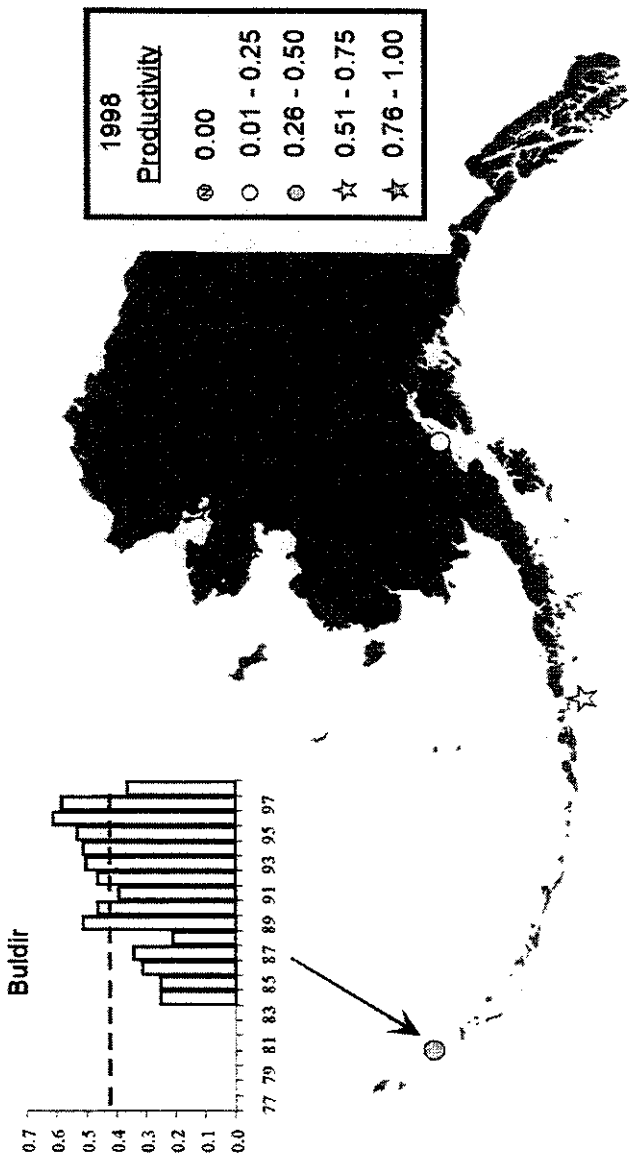

Figure 27. Productivity of horned puffins (hatching success) at Alaskan sites monitored in 1998. Lack of bars on graphs indicates that no data were gathered in those years. Dashed line is the mean productivity at the site in all years for which there are data (current year not included).

Populations.--Although plots have been set up at Buldir to monitor trends in horned puffins, no accepted method of monitoring has been developed, and no counts were made in 1998.

CONCLUSIONS

Species Differences

Surface Plankton-Feeders.--In 1998, the timing of hatching for fork-tailed (FTSP) and Leach's storm-petrels (LHSP) was average or slightly early at St. Lazaria (Table 24). Both species of storm-petrels had approximately average rates of reproductive success everywhere we monitored them in 1998 (Table 25). Based on the sites where population indices were measured in 1998, it appears storm-petrel burrow counts (both species combined) have been increasing recently (Table 26).

Surface Fish-Feeders.--Glaucous-winged gulls (GWGU) are treated here, although they are opportunistic feeders taking other birds as well as fish for prey. We had one sampling site in each of the regions where this species occurs, south of the northern Bering and Chukchi seas. In 1998, gull eggs hatched earlier than average at two Bering Sea sites (Aiktak and Buldir) but were average or late in the Gulf of Alaska (Table 24). Gulls had average success in 1998 at all the sites we monitored except Duck (Table 25). Numbers apparently have remained relatively stable at sites in the Aleutians and the Gulf of Alaska (Table 26).

Black-legged kittiwakes (BLKI) had earlier hatch dates in 1998 than normal in the Chukchi Sea (Cape Lisburne). Nesting chronology apparently was normal at 4 of 6 sites in the Bering Sea but was later than normal at the other sites in the Bering Sea and at most sites in the Gulf of Alaska (Table 24). Complete or nearly complete (less than 0.1 chicks fledged per nest) reproductive failures occurred in 1998 at most sites in the Gulf of Alaska; exceptions were Gull Island and Prince William Sound where success was within normal bounds (Table 9, Fig. 12). In contrast, black-legged kittiwakes had average or above average rates of success at most colonies in the Bering and Chukchi Seas (Table 25). Population trends at most colonies we monitored in 1998 have been relatively stable or increasing over the past decade. Exceptions were two sites in the Gulf of Alaska, Duck and the Semidis, where recent declines are suggested by counts on index plots (Table 26).

Red-legged kittiwake (RLKI) eggs hatched at approximately average dates in the Pribilofs (St. Paul and St. George) and at Buldir in 1998 (Table 24). Reproductive success was average or higher at all three sites monitored (Table 25). Although the breeding population at Buldir is higher than in the 1970s (Table 26), counts since the mid-1980s have been relatively stable (Fig. 15). Numbers of the recently established population at Koniuji continued to increase in 1998.

Diving Fish-Feeders (nearshore).--Timing of nesting events has been monitored long enough for comparisons at only one site each for pelagic (PECO) and red-faced cormorants (RFCO), both in the eastern Bering Sea. Hatching for pelagic cormorants was normal at Cape Peirce in 1998, but red-faced cormorants hatched later than average at St. Paul (Table 24).

Productivity for at least one species of cormorant was monitored in every region. Like other nearshore feeders, reproductive success may be based on very local conditions which may not prevail region-wide. Pelagic cormorants had average success at Bluff and Nunivak in the northern Bering Sea, but farther south in the Bering Sea and in the Gulf of Alaska rates of

Table 24. Seabird relative breeding chronology compared to averages for past years within regions.

Region	Site	Cormorant PECO/RFCO	Gull GWGU	Kittiwake BLKI/RLKI	Murre COMU/TBMU	Auklet LEAU/CRAU	Puffin TUPU/HOPU
N. Bering/Chukchi							
	C. Lisburne			--/*	=/--		
	L. Diomede			+/*	=/=	+/+	
	Bluff			=/*	=/*		
SE Bering							
	St. Paul	*/+		=/=	+/+		
	St. George			+/=	+/+		
	C. Peirce	=/*		=/*	=/*		
	Aiktak		--				
SW Bering							
	Buldir		--	=/=	*/=	=/+	--/=
	Kasatochi					+/+	
N. Gulf of Alaska							
	Semidis			+/*	+/*		+/*
	Barrens			+/*	=/*		
	Gull		+	+/*	=/*		
	Duck		=	=/*	+/*		*/=
Southeast							
	St. Lazaria				=/=		

Codes:

"--" indicates productivity was >3 days earlier than average for the site or region,

"=" indicates within 3 days of average,

"+" indicates >3 days later than average,

"*" indicates the species (in particular species pairs) was not present or was not monitored in 1998.

Table 25. Seabird relative productivity levels compared to averages for past years within regions.

Region	Site	Storm-petrel FTSP/LHSP	Cormorant PECO/RFCO	Gull GWGU	Kittiwake BLKI/RLKI	Murre COMU/TBMU	Auklet PAAU/LEAU/CRAU	Puffin RHAU/TUPU/HOPU
N. Bering/Chukchi								
	C. Lisburne				=/*	=/=		
	L. Diomede				+/*	=/=	* / = / --	
	Bluff		=/*		=/*	=/*		
	Nunivak		=/*		=/*			
SE Bering								
	St. Paul		*/+		=/+	--/--		
	St. George				+/+	--/=		
	C. Peirce		--/*		=/*	--/*		
	Aiktak	=/=	=/=	=		--/--		* / = / =
SW Bering								
	Buldir	=/=	--/*	=	=/=	=/--	= / = / =	* / -- / =
	Ulak	=/*	--/+					
	Kas/Kon[a]		--/--		=/*	--/--	* / = / =	
N. Gulf of Alaska								
	Semidis			=	--/*	--/--	-- / * / *	= / * / *
	Chiniak Bay		--/--		--/*			
	Barrens			=	--/*	=/*		* / -- / *
	Gull		=/*	=	=/*	=/*		
	Duck			--	--/*	--/*		* / * / --
	Chiswells				--/*			
	PWS				=/*			
Southeast								
	St. Lazaria	=/=	--/*	=		=/=		= / = / *

Codes:

"--" indicates productivity was >20% below average for the site or region,

"=" indicates within 20% of average,

"+" indicates >20% above average,

"*" indicates the species (in particular species pairs) was not present or was not monitored in 1997.

"ND" indicates that previous data are not available.

[a]Kasatochi and Koniuji islands combined for reporting purposes.

Table 26. Seabird population trends compared within regions.

Region	Site	Storm-petrel FTSP/LHSP	Cormorant PECO/RFCO	Gull GWGU	Kittiwake BLKI/RLKI	Murre COMU/TBMU	Puffin TUPU
N. Bering/Chukchi							
	C. Lisburne				=/*	+[a]	
	Bluff				+/*	=/*	
	Nunivak				=/*	=/*	
SE Bering							
	C. Peirce		+/*		=/*	--/*	
	Aiktak	+[a]	--[a]	=		=[a]	=
SW Bering							
	Buldir				=/+	*/+	
	Kasatochi		=[a]	=		=/*	
	Koniuji				=/+	+[a]	
	Ulak	+[a]				+[a]	
N. Gulf of Alaska							
	Semidis				--/*	+[a]	
	Chiniak Bay		--/--		=/*		
	Barrens			=	=/*	=/*	
	Gull				=/*	+/*	
	Duck				--/*	--/*	
	Chiswells				=/*		
	P. William Snd.				+/*		
Southeast							
	St. Lazaria	+[a]	+/*	=		=[a]	=

Codes:

"--" indicates negative population trend for the site or region,

"=" indicates no discernable trend,

"+" indicates positive population trend.

"*" indicates the species (in particular species pairs) was not present or was not monitored in 1997.

[a]Single symbols in a column with multiple species indicate that species were combined for population count purposes.

success were below average at 6 of 8 sites in 1998 (Table 25).

Red-faced cormorants had average or better success in the Pribilofs (St. Paul) and in the Aleutians, except at Kasatochi where rates were below average in 1998. Reproductive success was also relatively low at Chiniak Bay in the Gulf of Alaska.

At colonies in the Bering Sea where we made counts in 1998, evidence suggests that since the late 1980s, pelagic cormorants (or mixed species where they could not be distinguished) have increased or have not exhibited a trend at most sites (Fig. 8, Table 26). The exception is at Chiniak Bay in the Gulf of Alaska where both pelagic and red-faced cormorants have declined.

Diving Fish-Feeders (offshore).--Murres had average hatch dates at most sites in the Chukchi and Bering sea regions in 1998, but both species were later than average in the Pribilof Islands (St. Paul and St. George) (Table 24). Common murres (COMU) were late at 2 of 4 sites in the Gulf of Alaska (Semidis and Duck), but both species had average hatch dates in southeastern Alaska (St. Lazaria).

Murres exhibited average reproductive success at three sites we monitored in the Chukchi and northern Bering sea region in 1998 (Table 25). Farther south in the Bering Sea, common murres had below-average success at 5 of 6 sites and thick-billed murres (TBMU) had below-average success at 4 of 5 sites in 1998. In the northern Gulf of Alaska and in Southeast Alaska, productivity was within normal bounds ($\pm$ 20%) at three sites and below average at two sites (Table 25). Trends in numbers of murres at sites we monitored in 1998 have been either increasing or remaining relatively stable everywhere except Cape Peirce in the southeastern Bering Sea and Duck in Cook Inlet (Table 26).

Tufted puffin (TUPU) eggs hatched earlier than normal in the western Aleutians (Buldir) but were late in the Gulf of Alaska (Barrens) in 1998 (Table 24). Horned puffin eggs hatched during normal periods in the two regions.

Reproductive success for tufted puffins was below average in the western Aleutian Islands (Buldir) and in the northern Gulf of Alaska (Barrens), but was normal in the eastern Aleutians (Aiktak) and in southeastern Alaska (St. Lazaria) in 1998 (Table 25). Horned puffins had normal rates of success at Bering Sea colonies (Aiktak and Buldir) but were below average at Duck in Cook Inlet. No population trends were evident for tufted puffins (Table 26).

Diving Plankton-Feeders.--Least (LEAU) and crested (CRAU) auklets had relatively late nesting chronologies at most sites in 1998 (Table 24). The only exception was that least auklet eggs at Buldir hatched at normal dates. Whiskered auklets (WHAU) also hatched at normal dates there in 1998, but parakeet auklets (PAAU) were late at Buldir (Table 16). The only data on population trends are for least and crested auklets at Kasatochi where there appears to be a recent decline in the former species but not the latter (Fig. 21).

Regional Differences

N. Bering/Chukchi.--The timing of nesting events in 1998 for diving murres was normal at most sites, but surface-feeding kittiwakes were variable being early, average, and late at one site each (Table 24). Reproductive success was average for most species at most sites in the region in 1998 in this northern region (Table 25). The only population trend data are for offshore fish-feeders (kittiwakes and murres), and these species are either relatively stable or increasing (Table 26).

SE Bering.--Hatch dates for fish-feeders were normal at Cape Peirce, but in the Pribilof Islands, the onset of nesting tended to be later than usual for red-faced cormorants, murres, and black-legged kittiwakes (Table 24). Gulls hatched earlier than usual in the southern part of this region (Aiktak). Interestingly, red-legged kittiwakes tended to nest within the normal date range in the Pribilof Islands in 1998.

Storm-petrels apparently had adequate plankton available for normal reproduction, and cormorants, gulls, kittiwakes, and puffins also found enough fish for normal or higher rates of productivity at most sites in the region in 1998. Surprisingly, murres had problems in the southeastern Bering Sea, experiencing below-average rates of success at most sites (Table 25). Rarely do diving fish-feeders have low rates of productivity when surface-feeders have high rates, but that was the case in 1998.

Storm-petrel populations appear to be increasing in the eastern Aleutians (Aiktak). There were no clear patterns among fish-feeders in this region (Table 26): 1) cormorants were up at one site and down at another; 2) there were no sustained trends in kittiwake, gull, or puffin populations, and 3) murres were down at one site and showed no trend at another.

SW Bering.--Gulls and tufted puffins initiated nesting earlier than usual in 1998, but kittiwakes and murres were normal, at least in the western Aleutians (Table 24). In contrast, plankton-feeders (auklets) tended to be later than normal.

Plankton feeders, both surface (storm-petrels) and divers (auklets) had average success in 1998 in all cases (Table 25). Surface feeders (gulls and kittiwakes) had mostly average success, but diving fish-feeders (cormorants, murres and puffins) had below-average success in 8 of 11 cases (species x sites).

For all the species we monitored in 1998, no population declines were noted in this region (Table 26). Storm-petrels, murres, and red-legged kittiwakes have all demonstrated increasing trends in the past 10-20 years at colonies in the southwestern Bering Sea region.

N. Gulf of Alaska.--Fork-tailed storm-petrels normally are monitored at the Barrens, but data were not available for 1998 at the time of this report, therefore, only fish-feeding species are compared. No species nested earlier than normal in 1998 (Table 24). Surface feeders were later than average in 4 of 6 cases, and murres and puffins were late in half the cases.

Productivity was normal or below-average for all the species we monitored in this region in 1998 (Table 25). At most colonies near the Kenai Peninsula (Duck, Gull, Chiswells) and Chiniak Bay (Kodiak) most species had below-average success, whereas at Gull in lower Cook

Inlet and in Prince William Sound (kittiwakes only), success was normal. In the Semidi and Barren islands, results were mixed, with at least half the species at each site being below average (Table 25).

Although cormorant populations appear to be declining at the site we monitored in the region, overall patterns are not so clear for the other foraging guilds. Declines have occurred for kittiwakes in the Semidis and at Duck where murres have also declined. Elsewhere kittiwakes have increased (Prince Williams Sound) and murre numbers are up in the Semidis and at Gull Island. In all other cases there were no indications of trend (Table 26).

Southeast.--We had little historical data on timing of nesting events for most species at St. Lazaria, but murre eggs hatched at average dates in 1998 (Table 24).

Productivity rates in 1998 were average for every species except pelagic cormorants which had below-average success (Table 25).

Apparently, conditions are good for breeding seabirds in this region because no population declines were indicated for species we monitored and several species (storm-petrels and cormorants) are increasing (Table 26).

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